Smithsonian

January 1990

Ravenna's glowing mosaics are still shedding light (p. 54)

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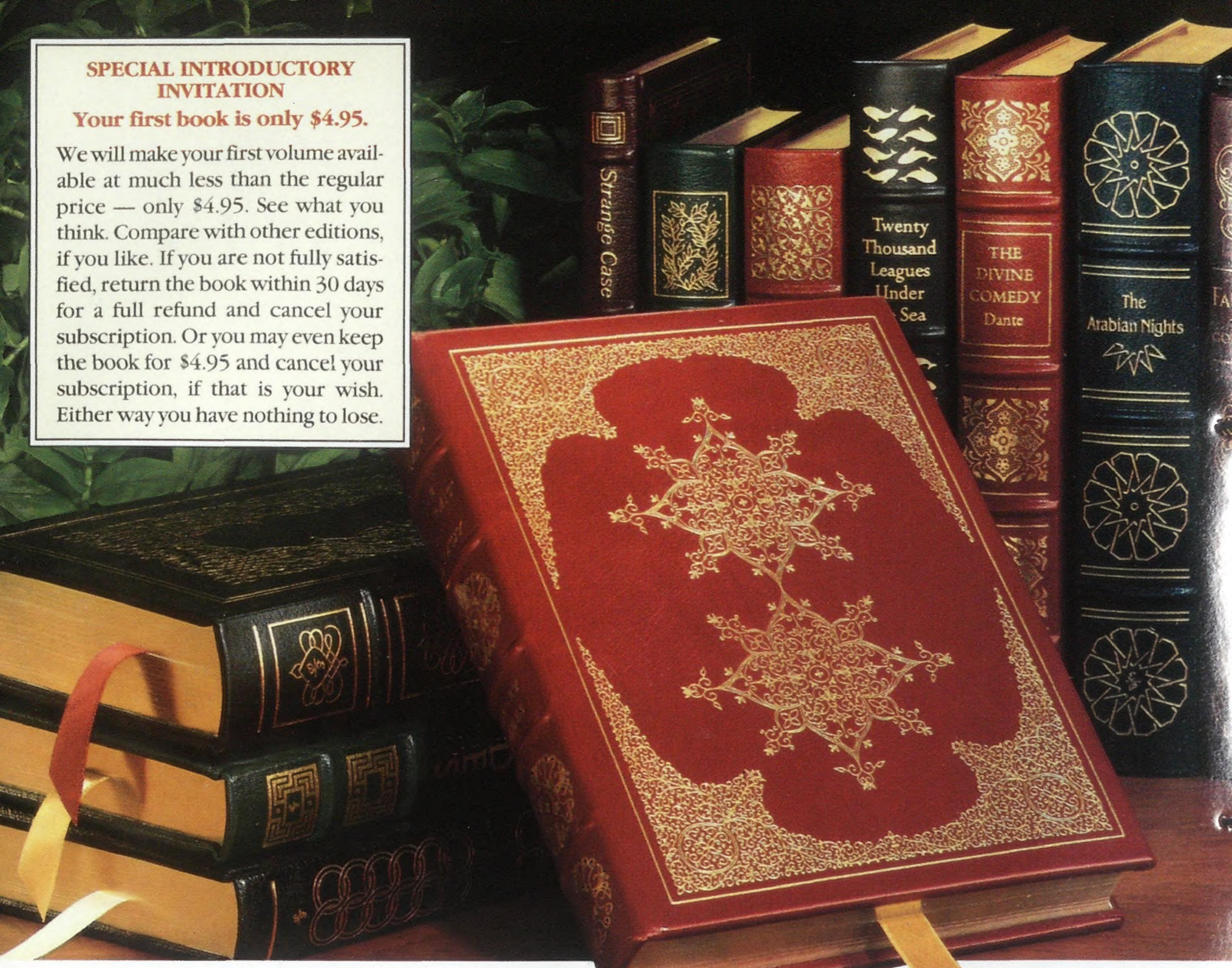

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Volume 20, Number 10

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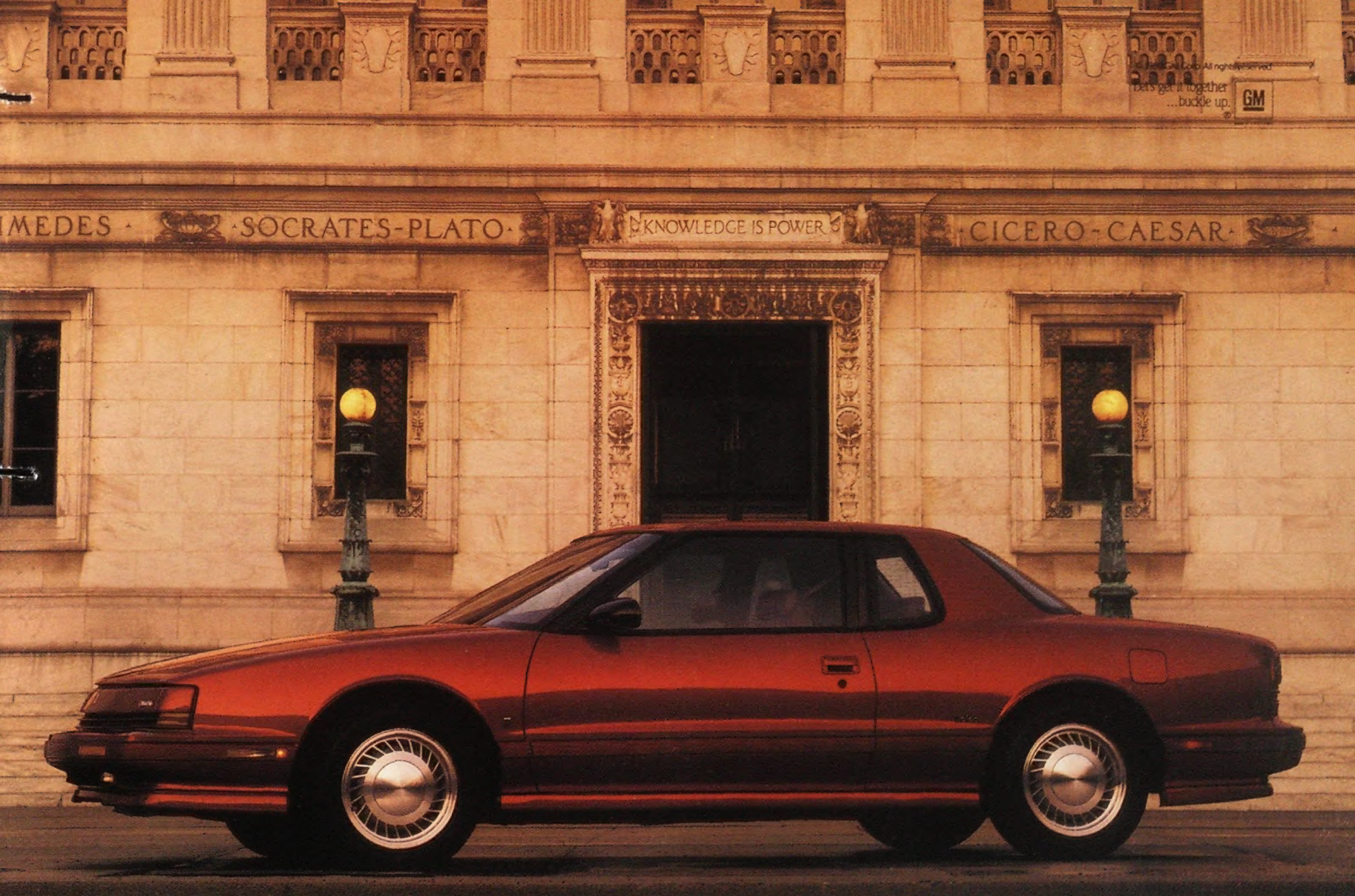

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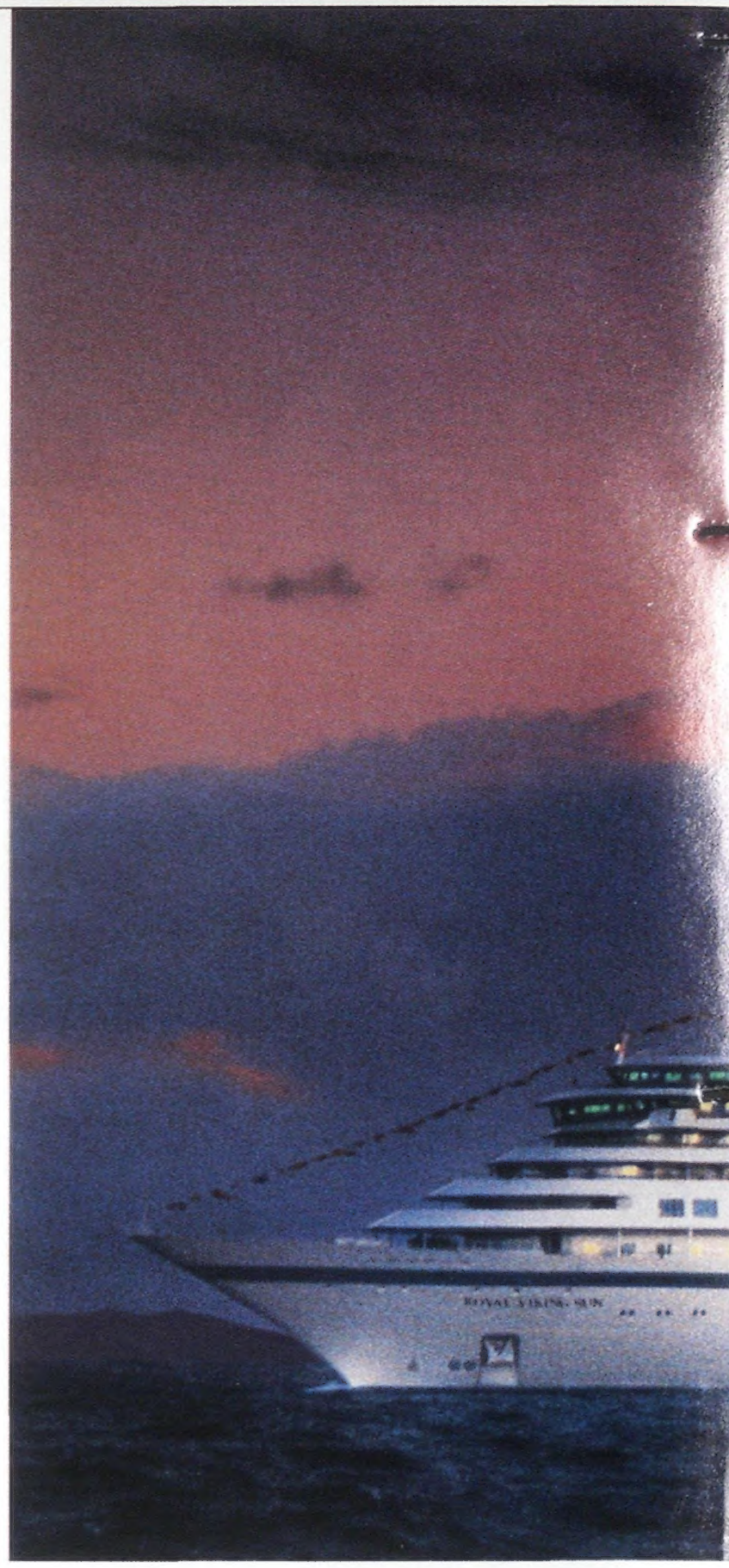

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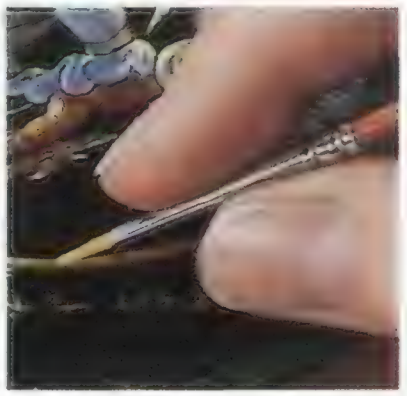

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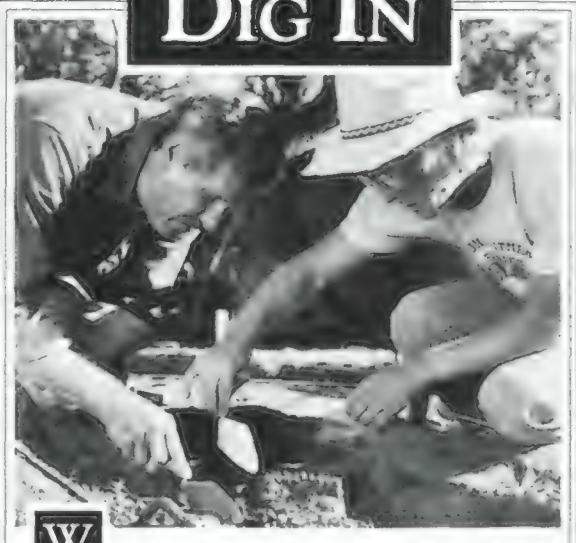

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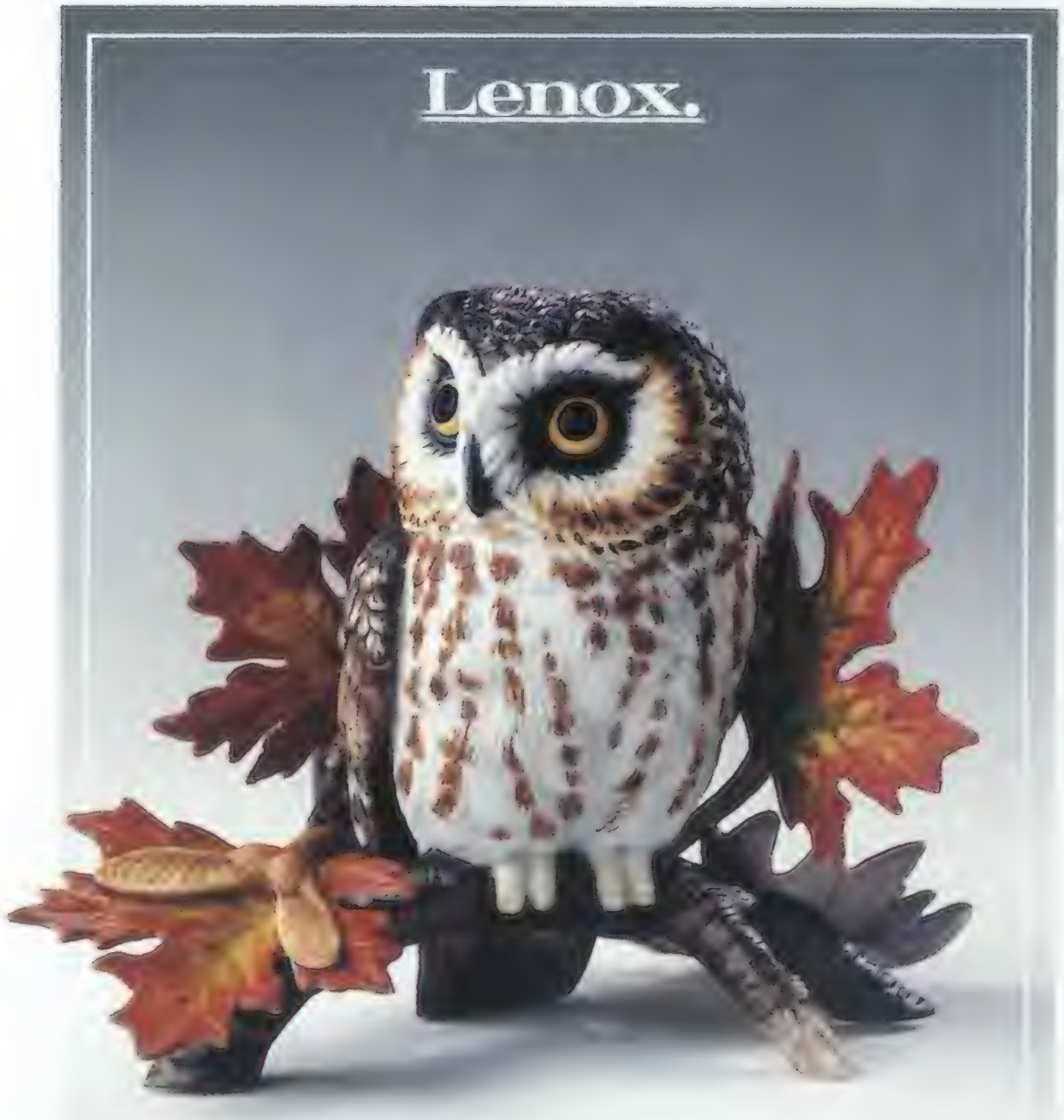

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Smithsonian horizons

Ambitious undertakings involving science and technology are what America does better than anyone

We are all familiar with the voracious American appetite for Japanese and other foreign goods. In a matter of only a generation or so, a large proportion of the public has almost come to take for granted that our own consumer products are frequently not comparable in design, workmanship or trouble-free performance. Quite apart from its adverse impact on our balance of trade, this pronounced, long-term shift in our attitudes invites further attention. What, if anything, can we still say with confidence that the United States does as well as, or better than, anyone else?

Great, truly ambitious, science-and-technology-based undertakings, for one thing. Following on wartime prototypes, the construction of the enormous Interstate Highway System and the Apollo Project are outstanding examples. The "giant step for mankind" onto the moon's surface followed by only eight years President Kennedy's call to action for the effort. After the apparent slackening reflected in the Challenger shuttle disaster, President Bush's proposal last July that we return to the moon and go on to Mars must surely signal a revival of will and nerve.

The Superconducting Super Collider (SSC), on which construction is soon to begin near Dallas after seven years of planning, is a further example. By a factor of 20 times or so, this will be the world's largest accelerator of subatomic particles. It will hurl opposing, minutely focused (less than .04 inches in diameter) beams of protons around a 52-mile track until they are directed into one another after reaching the unprecedented energy level of 20 trillion electron volts, nearly the speed of light.

The resulting collisions are expected to produce cascades of extremely short-lived hadrons, leptons and other, still-smaller, particle components. Sophisticated electronic detectors will make it possible to deduce not only their masses but the yet-deeper forces normally holding them together. To be tested in this way is the so-called Standard Model of contemporary high-energy physics, which is thought to account for all presently observable phenomena—but only on the assumption that a Higgs boson, a subatomic particle first postulated by the Scottish physicist Peter Higgs (SMITHSONIAN, March 1989), will presently be detected by the SSC.

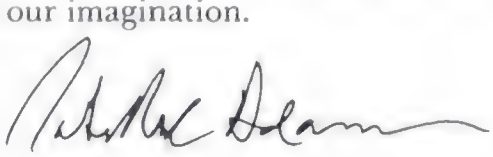
All of this will take place seven or eight years hence, when the SSC is finally ready to be fired up. More at issue at the moment are the great electromagnets—10,000 of them, each costing in the neighborhood of $100,000—that will be arrayed around the ring to focus and accelerate the protons. Questions have been raised, as project director Roy Schwitters acknowledges, about their "operating margin, reliability, manufacturability, and reproducibility." As work on the prototypes continues, however, it is increasingly evident that the most serious difficulties have now been overcome.

Because of the enormous current needed to generate sufficiently powerful magnetic fields, the electric cables and windings of these large magnets need to be superconductive. Made of a special alloy and bathed in liquid helium, they will be maintained at a temperature only a few degrees above absolute zero. The forming of these cables is itself a technological tour de force. Copper sleeves 3 feet long and 14 inches in diameter are filled with niobium-titanium rods, then repeatedly compressed and drawn until they are almost a hundred miles in length. Suggesting the scale of this part of the project is its requirement of 2,500 tons of the superconducting alloy, which will dwarf current world production of only about 300 tons per year.

What initially stimulated my interest was a remark by Raphael Kasper, associate director of the project. He observed in casual conversation that the placement and performance of each of these magnets needed to be "perfect." In apparent contrast to the reputed slide in our general level of manufacturing performance, how will the producers manage to achieve such high and uniform quality?

Tom Bush, former Navy missile engineer and head of the SSC Magnet Division, had several quietly matter-of-fact answers: prolonged refinement of basic magnet design; painstakingly careful scrutiny of materials "all the way back to the copper"; lots of attention to process control; more intensive examination of junctions and linkages, where the majority of failures in fact occur; just-in-time supply methods, borrowed from the Japanese, to minimize stockpiling. And of course, testing, testing, and more testing at every stage.

In the end, his calm assurance overcame at least my skepticism. He confidently plans to produce ten magnets a day for four years, and then, in some ways not much less important, to set loose for other high-tech employment 30 to 35 industrial engineers who really know something about their business. Projects like this of course have their own primary purposes. But they also help us to retain our grasp on the technical and human capabilities that will continue to take us to the supreme limits of our imagination.



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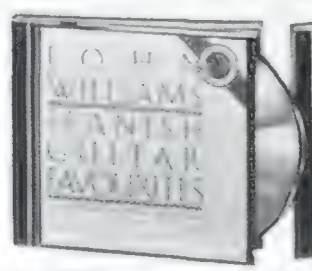

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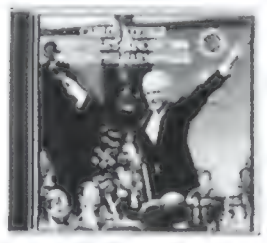

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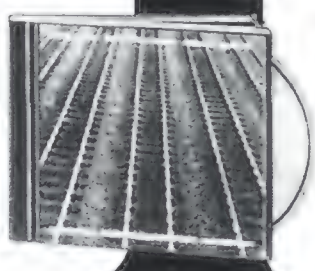

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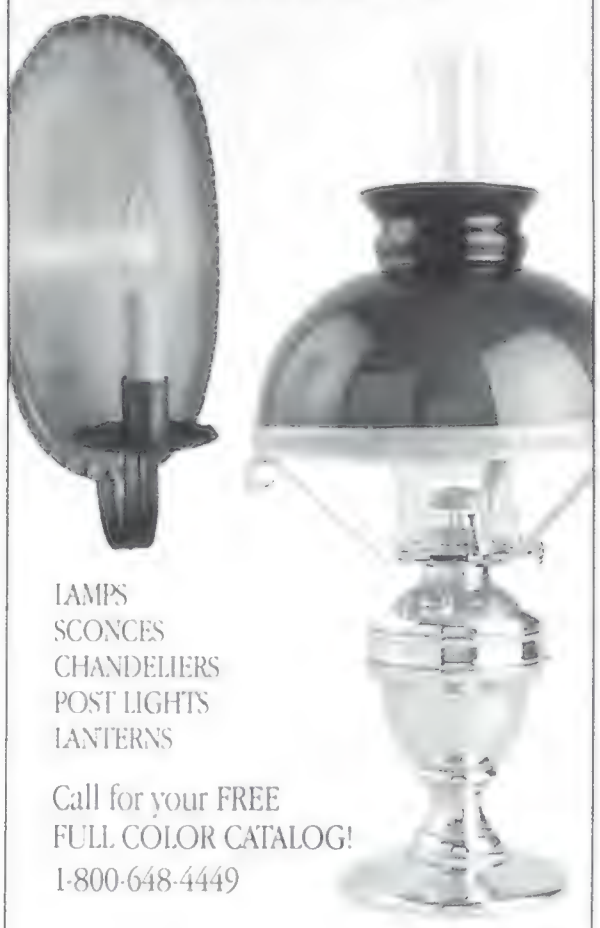

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Letters to the Editor

The Amazon

Dear Sir: Your November article had special interest for me as I am an American Indian from Alaska. A lot of the problems native Americans are dealing with today have been complicated by missionaries, who taught us the white man's ways. In the process we lost many values that had sustained our people for thousands of years.

I suggest that missionaries learn from the Indians before trying to teach or change them. I have studied my people's history from before contact with whites through the changes brought about by that contact. To work with either society one must understand both.
Lincoln Tritt
Arctic Village, Alaska

Adobe builders

Dear Sir: Researchers from Northern Arizona University and the Arizona State Museum have recently documented adobe-brick walls at two 14th-century pueblos within our park. Seven other examples of adobe-brick architecture at prehistoric sites on the Colorado Plateau are also known. One has provided evidence that frames were used in brick-making. It appears the practice of building with adobe originated in the San Juan region during the 12th century, then spread southward.

It is time to set aside the longstanding assumption that adobe bricks were introduced by the Spanish.
Douglas Johnson
Homolovi Ruins State Park
Winslow, Arizona

Dear Sir: I envy the half-million Americans living in adobe homes, but a recent book by architect Nader Khalili reminded me that tens of millions more throughout the Mideast, Asia and Latin America live less graciously in mud-brick houses subject to rain, snow and earthquake damage. His brilliant solution: dome- and vault-shaped homes built of 8-by-8-by-2-inch traditional Iranian bricks, made more resistant to the elements by firing from within, as in a kiln. The result: rock-hard ceramic houses.

Khalili's successful experimental structures include a ten-classroom school, and a number of domes and vaults in the Third World, Europe and Southern California. The latest, a 27-foot-diameter dome in New Cayuma, California, was constructed by architecture students from all over the world.
Joseph Denker
Studio City, California

Adobe builders and Robert Goddard

Dear Sir: I was raised in Roswell, New Mexico. My father, Pablo Carrasco Ornelas, built our home of adobe and was involved with the pioneer space program.

He helped Goddard mix the rocket fuels when they weren't real sure what would happen after they combined the ingredients. We, his children, were the labor force for his adobe production.
Erlinda Ornelas Britt
Tampa, Florida

Oklahoma Land Rush

Dear Sir: On page 202 the author spoke of putting your "John Henry" on the parcel of land you were claiming. The original John to invoke when actually signing your name was John Hancock, he of the flashy signature on the Declaration of Independence.
Stephen Olson
Belfast, Maine

Winold Reiss

Dear Sir: As retiring director of the Bradford Brinton Memorial Museum I would like to point out that the museum and the village of Big Horn are in Wyoming, rather than in Montana.

Also, your article implies that the Reiss collection constitutes the entire holdings of the Brinton Museum. In addition to the Reiss paintings, the museum features works by such artists as Frederic Remington, Charles M. Russell,

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Victor Th. Engwall

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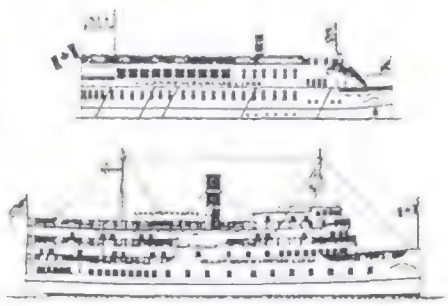

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Frank Tenney Johnson, E. W. Gollings and Ed Borein. The museum also has a substantial collection of American Indian artifacts as well as an extensive collection of Americana associated with the historic Brinton Ranch.
James T. Forrest
Big Horn, Wyoming

Dear Sir: My only regret was in not seeing at least one of the superb mosaics Reiss did for the Cincinnati Union Terminal. Several are now at the Greater Cincinnati Airport and are as exciting today as when completed in 1933.
Margaret Minster
Cincinnati

U.S. Playing Card, a factory scene by Winold Reiss, is at Cincinnati Airport.

Opossums

Dear Sir: Four young possums appeared last May at the plant where I work. I took them home, fed them cat food and oatmeal until each weighed a pound or so. (They can't eat a meal without stopping to wash hands and face at least once.) Then my husband and I took them out to the Pee Dee Wildlife Refuge and turned them loose one fine July evening. All marched right off without a backward glance, foraging and rummaging through the grass in finest possum style. In a few minutes they disappeared into the woods, in four different directions.

We colored their tails with Magic Markers to tell them apart, but before long we knew them as individuals. Blue and Black were touchy and short-tempered. Plain was so timid she would stop and stare for half an hour at anything suspicious, and when picked up

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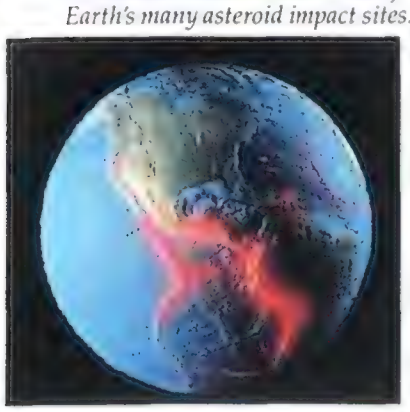
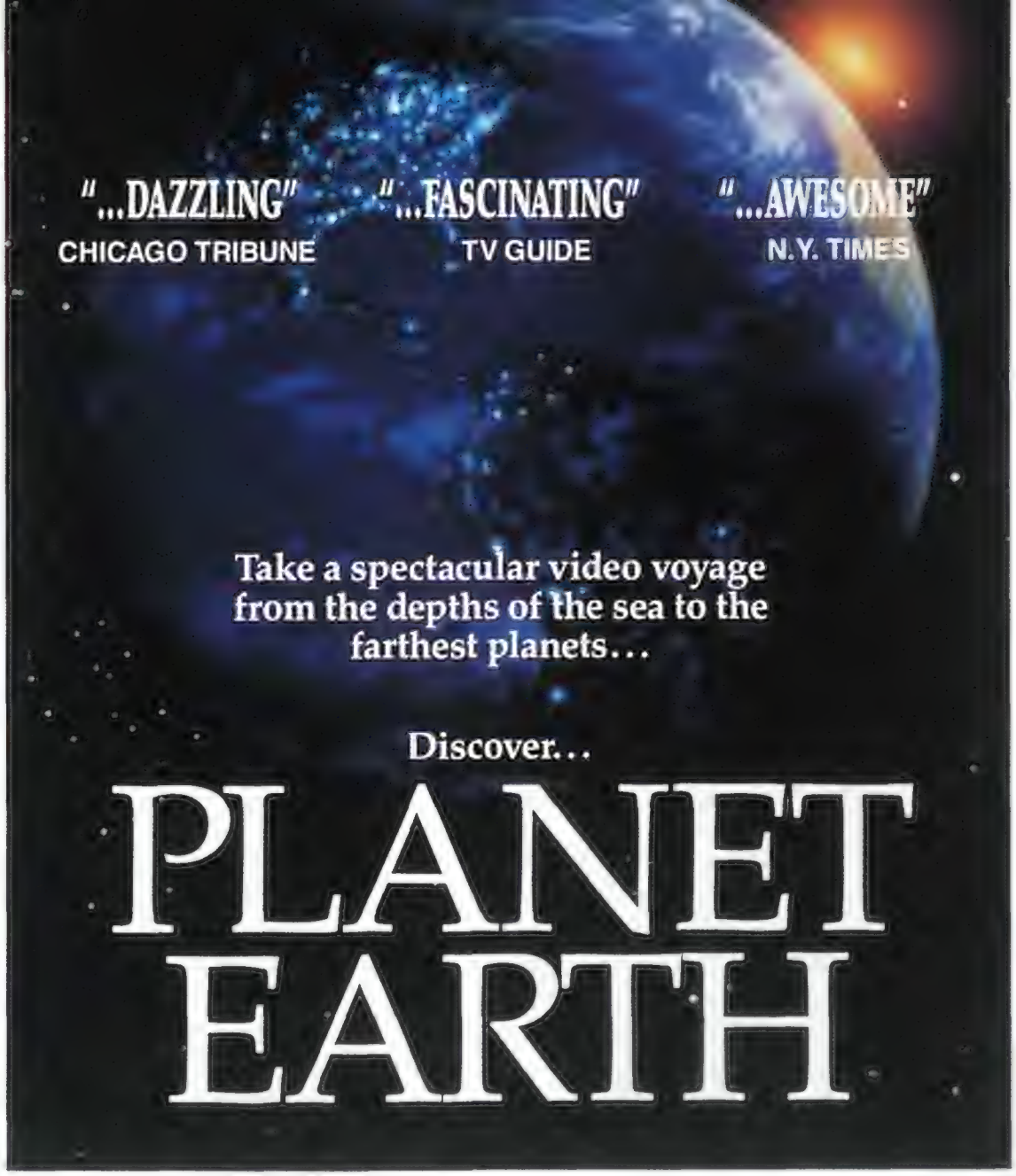
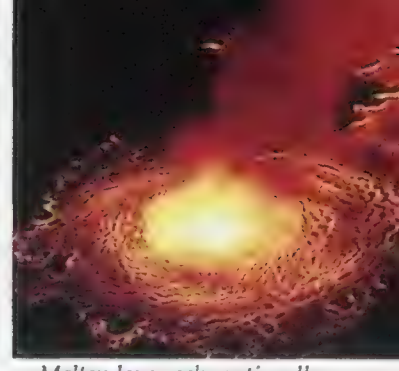


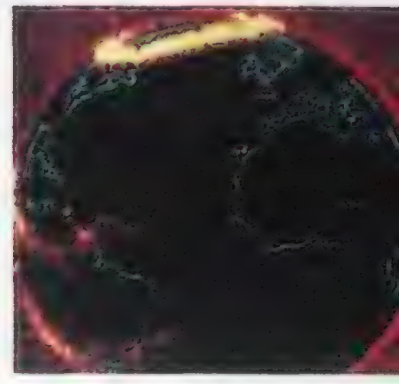
An ancient "supercontinent" tearing apart to form today's world.





Molten lava rock continually reshapes the Earth's surface.

Earth's rotation helps create hurricanes, as seen from space.



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Allow 6 to 8 weeks for shipment
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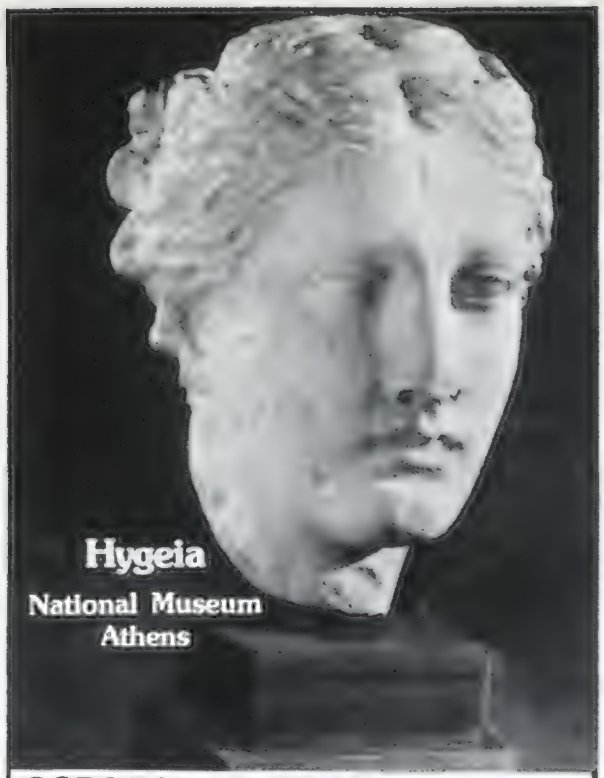

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David Morgan
11812 Northcreek Pky. N., Suite 103, Bothell, WA 98011

was the most likely to freeze up and "die." Red didn't care. We could handle her at will. She was always the first to relax and explore the kitchen table for tidbits, always the first to the food dish and the last away. She gained twice as much as the others. She let us feel her paper-thin ears (no wonder they freeze off so easily) and the inside of her pouch: it's like velveteen.
Maggie Nelson
Monroe, North Carolina

Dear Sir: When I was younger I had a pet opossum. His name was just Possum and he ate dog food and marshmallows, and was bathed once a week by my mom. Possum lived in a box in our kitchen and rode around on my shoulder, usually wrapping his tail around my neck. He lived with us for two and a half years before being let go in the wilds of Mississippi. Of all our pets he was the cleanest, cutest, most popular a little girl of 12 could ever have had.
Jamie Medved
Lower Burrell, Pennsylvania

World War I posters

Dear Sir: In World War I we supported the Red Cross by knitting sweaters, caps and socks. In 1917, when I was 11, artist Christian Midjo painted a picture of me in a blue dress against a Stars and Stripes background for a poster urging "Help Save the Children"—by buying War Savings Stamps.

My brother was a Boy Scout and he and several Scouts distributed posters around town for store windows, the post office, libraries and so forth. There was always a surplus, and at the end of the war he put his away. Recently, he gave them to our daughter; they were much appreciated as collector's items.
Elizabeth Baker Wells
Ithaca, New York

Dear Sir: After the invasion of Belgium by German troops, and the imposition of the British blockade, most Belgian civilians were forced to live on a starvation diet. Starting in 1914, Herbert Hoover, who was chairman of the Commission for Relief in Belgium, convinced the German government that the commission was entirely neutral, and it was permitted to send many millions of dollars' worth of wheat to Belgium.

The grateful Belgians showed their thanks by returning some of the flour sacks, on which the Belgian women had embroidered the years 1914, 1915 and 1916 with a circle of roses and the words "*Reconnaissance du peuple Belge*" ["In gratitude from the Belgian people"].
Maurice B. Rosalsky
Englewood, New Jersey

Dear Sir: I believe you have misinterpreted the message of the poster on page 127. "*Or*" really meant "gold" in this instance and not just "money." In wartime France it was patriotic to exchange your gold coins—Louis—for banknotes because the French Treasury needed badly to back up the value of the French monetary unit, the franc. Hence, "For France, pour out your gold" and "Gold fights for victory" meant turn in your gold coins for banknotes.
Mrs. A. B. Todorou
Northport, Alabama

Umbrellas

Dear Sir: In the vintage days of radio, Colonel Stoopnagle used to announce he had invented a contraption that looked like an umbrella, but was not an umbrella—for people to carry when it looked like rain, but was not raining.
Irving Hodas
Brooklyn, New York

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TODAY'S CHEVROLET™

Around the Mall and beyond

The phrase "Pepsi generation" hasn't yet found its way into my newest dictionary. But give it time. "Moxie" is in there. It's defined as slang for "1) vigor, verve, pep; 2) courage and aggressiveness, nerve." But as really very old people like me can remember, Moxie was a soft drink of the 1920s, notable for its red signs on every roadside store and filling station, urging you to drink it.

Those signs pitted me, for the first time, against advertising. It won effortlessly. Boy, did I want to drink Moxie! Years later, I saw my own children face the onslaught of various soft drink ads. They folded before every one of them. Coke, Pepsi, Dr Pepper, Mountain Dew, Sprite . . . the refrigerator bulged with one brand after another. Oh, well. They all taste a lot better than Moxie.

"Pepsi generation" may not be in the dictionary yet, but it's in the American vocabulary. So is "Try it, you'll like it" and "I can't believe I ate the whole thing!" Similarly, certain visual images have become as familiar to us as our next-door neighbors: Marlboro Country, Speedy Alka-Seltzer. Like it or not, advertising is part of our culture.

That's enough to get it into the Smithsonian. To see how advertising is making out so far from Madison Avenue, I charted a course to the Center for Advertising History in our Museum of American History. It's a feature of the Smithsonian Archives Center, which exists for the use of researchers. You find the Archives Center between some third-floor exhibits. The glass doors are electronically controlled so visitors can be screened to make sure they're serious researchers. They opened only grudgingly for me.

I found the ads worth the trouble—a lively and often nostalgic gathering of visual memories and the stories behind them, stretching back to the last century.

Here are advertising storyboards—poster-size panels on which TV shots are sketched in sequence and ideas explained to skeptical would-be clients. Here are lavish annual reports, promotional materials like Campbell Soup cookbooks, items as dull as market research reports, and as lively and often irreverent as the taped reminiscences of creative people who brainstormed some of the great advertising campaigns.

The collection is not on exhibit, though as Stacy Flaherty says, "we often add items to various displays." Flaherty is program coordinator for the Archives Center. She's a quickly cordial young woman, wondrously petite and infallibly knowledgeable. She introduced me to the archivist, John Fleckner, who isn't petite, but is just as cordial.

They led me into one of the storage rooms where stacks of shelves can be rolled apart to create aisles. Here, filling two-thirds of the shelves in aisles 29 to 34, is the Warshaw Collection of more than a million advertising items. The ad business was ironically uninterested in documenting its own history until, in the 1920s, Isadore Warshaw of New York started amassing all kinds of advertising material. He sold the lot to the Smithsonian in 1967.

"That," said Fleckner, "got our own collection moving." The Archives Center has sorted the Warshaw Collection into 575 categories. Among the best-represented are railroads and patent medicines. One of the oldest ads is, of course, Ivory Soap, "99 44/100% Pure." That fraction is the key. If they'd written it "99.44" it would have looked like math, and no one would have read it.

If you doubt that ads reveal the life of their time, look carefully at the clothes, the hairdos, the bathing costumes, the backgrounds, in the earlier visuals. A 1900 ad for overshoes shows a muddy, rutted street in the middle of a town. A seed company ad has two fashionable ladies surveying a watermelon crop from a beautiful little two-wheeled buggy.

My favorite oldie is an ad for Fatima cigarettes. A tall gentleman, elegantly clad in high-standing stiff collar, well-tailored hacking jacket, jodhpurs and leather riding boots, stands in front of a Blériot monoplane—the type that in 1909 first flew the English Channel. In the background, beyond the roof of shed

Speedy Alka-Seltzer was one of TV's first stop-motion animation characters.

No. 19, a distant biplane glides down for a landing.

The gentleman is waiting for his mechanic to finish bracing the flying wires, which reinforce the wings—no job for a patrician like this. His left hand is negligently tucked into the side pocket of his jacket. In his right he holds a Fatima. You know that until you learn to handle a cigarette with that casual assurance, you'll never get off the ground.

In the Warshaw tradition, our Smithsonian people have continued saving advertisements that reflect the world of the later 20th century. Fatimas and Blériots faded away, and the Marlboro Man cantered onto Madison Avenue to mark forever our American infatuation with the cowboy myth. So widespread is the appeal of Marlboro Country that it can now be almost anywhere in the world. The cigarettes were originally British, back in the late 19th century, but were marketed in the States in the 1920s as being especially chic for women. The cowboy connection came a few decades later to promote the idea that real he-men smoke filtered cigarettes. An interview with John T. Landry, who managed the advertising for Marlboro, reveals the importance of music in the Marlboro Country television spots. A lot of footage had been shot of beautiful Western scenery. Then one of the creative people brought in a record and tried it as background. "All of a sudden it came together," says Landry. "The whole campaign jelled." The record?

Why Nobody In Professional Football Can Compete With The Bears.

Thomas Kitchin / Tom Stack & Assoc

Or the lions. Or the bengals. Or the eagles. Or any of the animals at the zoo.

Each year in the United States, zoos attract more than 100 million people. A bigger draw than all professional football games combined.

Why are we innately fascinated by animals? And so compelled to talk to them, touch them, feed them and care for them? Those are just some of the questions we'll explore on the next episode of Smithsonian World, when we visit the National Zoo in Washington, D.C.

There we'll take a good look at nature. The nature of animals. The nature of humans. And the nature of their relationship. A relationship as perennial as life itself.

So watch "Zoo," proudly brought to you on PBS by Southwestern Bell. It will be broadcast January 24 at 8 p.m. Check your local listings.

Then get ready for a program that's in a league all by itself.

SMITHSONIAN WORLD

Southwestern Bell Corporation

A co-production of WETA, Washington, D.C., and the Smithsonian Institution. Funding provided by Southwestern Bell Corporation

GIVE A KISS

Genuine Stained Glass

Actual Size: 5"x7"

From London's Victoria and Albert Museum we discovered *The Kiss*, an evocative treatment of romantic love. The Stained Glass Guild artists, who make stained glass for major museums, carefully apply individual layers of transparent paint directly to the glass. They fire it in red-hot kilns, permanently fusing the paint and glass. Prominent blue and rose tones add to the beauty of this tender scene framed in glazier's lead. Give a *Kiss* as a wedding or anniversary gift—or to encourage romance at any time.

Please send _____ *The Kiss* stained glass art tableau(x). $22 each, plus $2.50 shipping. Includes hanging chain, clear easel, elegant gift box and Certificate of Authenticity.

☐ Please send full-color catalog ($2), good toward first reservation.

☐ Check enclosed for $ _____

☐ Charge $ _____ to: ___ VISA ___ MasterCard ___ American Ex

No. _____ Exp. _____

Virginia residents please add 4.5% sales tax

Name _____

Address _____

City/State/Zip _____

The Stained Glass Guild
Dept. 101 • 25 E. Main Street • Richmond, VA 23219
Call toll-free 1-800-446-7968.

The latest designer fashions featuring both comfort and style plus brand name shoes in regular and hard-to-find sizes.

SEND $1 FOR CATALOG AND $2 BONUS COUPON

Name _____

Address _____

City _____

State _____ Zip _____

MAIL TO: Serendipity®

Dept. AEL4, Palo Verde at 34th
P.O. Box 27500, Tucson, Arizona 85726-7500

It was the theme for the film *The Magnificent Seven.*

Times change. Cigarette ads must now contain the Surgeon General's warning. But though they've come a long way from that classy aviator and his Fatima, they still evoke the same sort of magical moment.

American interest in cars abides, but the annual appearance of new models has lost its impact. The advertising world of earlier years—shall we say "pre-Toyota"?—made a media ritual out of "New Model Day" every autumn. Flaherty showed me an ad for a 1952 Plymouth and pointed out a diagram of how a cylinder works. Obviously, New Model Day was a time to remind eager buyers of engineering basics.

The glut of advertising on television has been a daunting challenge for ad agencies—especially since remote controls make it so easy to mute an ad or switch a channel. There must be quick action, liveliness, sometimes humor.

Patrick Kelly, one of the originators of the first Federal Express ads, likes humor and recalls his Federal Express work as a lot of fun. It was a brand-new company when Ally & Gargano, where Kelly worked at the time, took on its advertising. "What we had to impress on everybody was the fact that this company existed," he says in his taped interview. It wasn't much of a company. Just a bunch of enthusiasts with an old airplane hangar and a few planes. "We showed all the planes lined up on the runway and the headline was, 'America, you have a new airline.' "

Kelly started the comedy approach about a year later with the "Pass it on" theme. "The idea," he says, "was that the chairman of the board gives a package to the president, saying, 'If this package doesn't get to Toledo by tomorrow, it's your job.' The president passes it along to the next guy, and so on down the line." A 1978 Federal Express print ad shows an executive hiding under his desk while his supervisor pokes his head in the door. The copy reads, "Spritzer, that package you sent to Albuquerque last night didn't get there! You're in big trouble, Spritzer!"

Kelly's gang expected criticism, and got some: the ads were negative, they made businessmen seem incompetent. "Actually, the idea was to show people that not using Federal Express was dumb," says Kelly. A part of this approach was the still-familiar theme, "When it absolutely, positively has to be there overnight." Kelly later played with going back in history to more-primitive shipping methods and lesser expectations: "I must have that package delivered in four months!" He called one such idea the Babylon bit.

"There was a slave in ancient Babylon, carrying a thick clay tablet across the desert," says Kelly, "and the copy goes something like: 'In 3000 B.C. it took a letter four days to go from one side of town to the other. Today, it still takes four days." The visual that accompanies it shows the slave arriving at his destination. He climbs a long flight of stairs, trips and drops the tablet. It shatters into a hundred pieces. Although this ad never ran, Kelly kept up the humor. Federal Express did use "fast-talking man" John Moschitta jr. in commercials Kelly conceived and wrote.

Agencies call on specialized actors to fill slots in television ads. Speedy Alka-Seltzer, the little animated fellow fashioned out of a couple of tablets, came chirping into our consciousness in 1952. His voice was that of an actor named Richard Beals. "When Beals came in, we felt we had the voice," says Forrest Owen, producer for the ad agency. "We'd tried women and children, but when they took Beals' tape to the client, it sold."

Roy Grace worked as an art director on the Alka-Seltzer account back when he was—in his own words—"a young, irreverent guy." He talked about "the blahs," which Alka-Seltzer set out to cure. Archivist Fleckner believes that "sometimes people invent a pill and an ad agency invents something for it to cure."

"The blahs" really meant a hangover, says Grace. But you weren't supposed to say that on a television network.

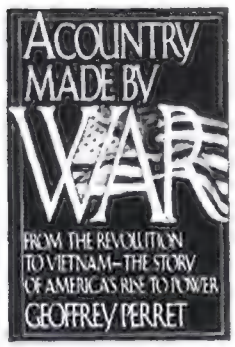
Alka-Seltzer was touted as the thing to take ("Plop, plop. Fizz, fizz. Oh, what a relief it is!") after unspecific overindulgence. Subjects would plow through banquets and then admit, through spasms of heartburn, "I can't believe I ate that whole thing!" (Yes, "that" was the original word.) Now, in the health-conscious '80s, people aren't supposed to drink enough to get a hangover or dig into anything so cholesterol-rich as Mama Magadini's Meatballs.

So what are the poor advertisers to do? Don't worry. They'll think of something. And someday a researcher at the Center for Advertising History will explain what it was.

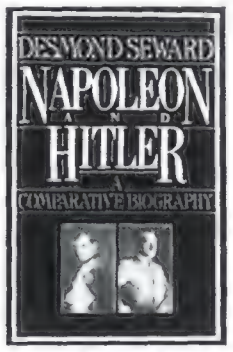
Edwards Park

TAKE ANY 3 FOR $1 EACH

Plus a 4th at the low Members' Price. **NO RISK, NO COMMITMENT.**

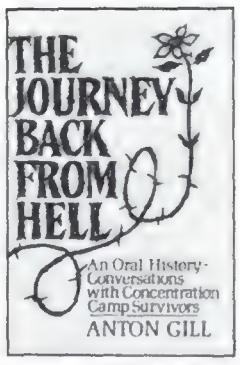


1719. $22.50/**$17.95**



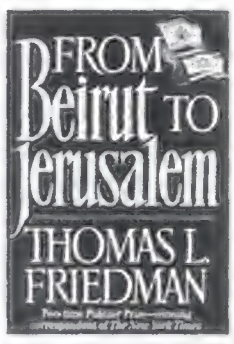
1891. $19.95/**$14.95**

1875. $22.95/**$18.50**

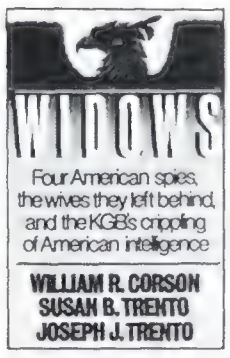


2121. $22.95/**$17.50**

1735. $21.95/**$17.50**

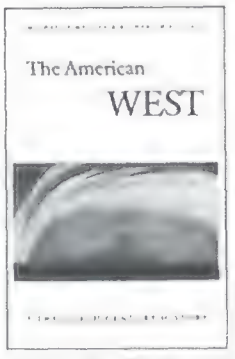


1925. $22.95/**$17.50**


WIDOWS
Four American spies, the wives they left behind, and the KGB's crippling of American intelligence
WILLIAM R. CORSON
SUSAN B. TRENTO
JOSEPH J. TRENTO

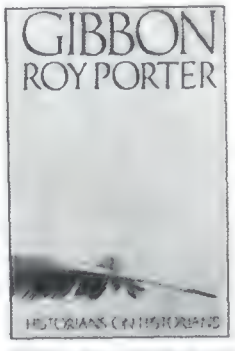
2345. $24.95/**$18.50**

2162. $27.50/**$21.50**

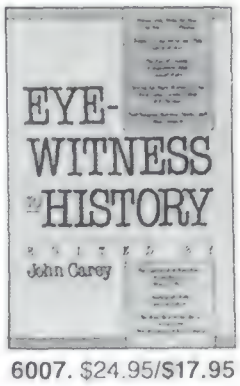


2675. $31.50/**$21.50**

2659. $22.95/**$17.95**

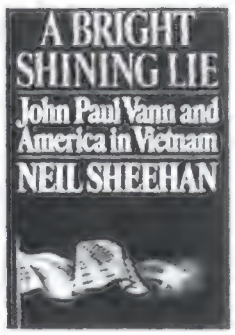


2022. $24.95/**$18.95**

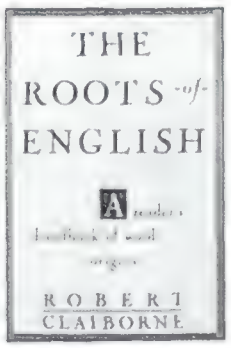


6007. $24.95/**$17.95**

7526. $17.95/**$15.50**



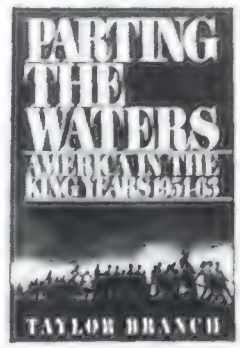
1495. $24.95/**$18.50**



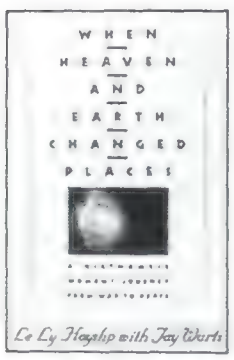
1933. $18.95/**$15.95**

9282. $22.50/**$16.95**

2410. $19.95/**$16.95**



1081. $24.95/**$18.95**

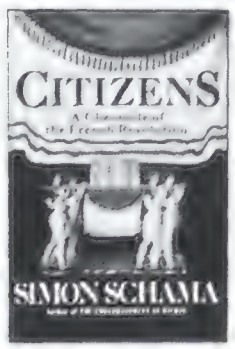


2261. $18.95/**$15.50**

2428. $21.95/**$16.50**

1792. $22.95/**$18.50**

1701. $24.95/**$18.95**



1396. $29.95/**$21.95**

3087. $18.95/**$16.50**

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THE EGYPTIANS AND SOFTWARE TECHNOLOGY

As you read this, you are partaking of the most important breakthrough in the history of civilization; the invention of writing.

Writing appeared almost simultaneously around 3300 B.C. in both Mesopotamia and Egypt. At first it served as an aid to accounting and administration. But very quickly its applications bloomed. Laws were codified and set down. Society was organized on a scale never before imagined. Science, philosophy, mathematics, and all forms of wisdom could be passed on from generation to generation. History itself has been defined by writing, and virtually every aspect of human life today has been affected by it.

Papyrus Book of the Dead. 1250 B.C. British Museum

Practically, writing has served as an amplifier of human thought. With each generation since its invention, the wealth of knowledge available to mankind has increased exponentially, allowing us to learn from the mistakes of our forebears and to build on their discoveries.

In our own age we are experiencing the birth of a breakthrough equal in magnitude to that of writing. In 1946 the first large-scale digital computer, ENIAC, came to life. Within a single generation nearly every aspect of our lives, from cooking to space flight, has been touched by computers.

At the heart of this breakthrough has been Lockheed. The applications of its software include battle management, strategic defense, ground and space-based communications, and intelligent flight systems. Lockheed's mastery of Ada, the Government's standard programming language, insures that the company will remain the nerve center of software development. In addition, Lockheed's application of its software proficiency to its own manufacturing not only reduces production time, but increases quality control.

Like writing, software technology has served to amplify the human mind. Phenomena that were once too complex to study are now open to us, and feats that were once impossible have become commonplace. The ramifications are limitless.

Civilization as we now know it would have been inconceivable without the invention of writing. But could the ancient Egyptians have imagined where their invention was to take their descendants? With the advent of software technology, the direction civilization will take over the next 5,000 years may be just as unimaginable to us. We are reading the preface to an incredible adventure.

Lockheed

Giving shape to imagination.

Do your heels ache?

Why suffer another day with sore heels (**and even heel spur aches**) when **Cushi-Heel Pillow** gives you quick relief **while you walk or run?** Developed by an athlete, who suffered just as you do, and who couldn't find anything which helped. His U.S. patented (No. 3,984,926) pads are exactly the right shape, density and compression to cushion the weight your heels must bear. Mailmen, housewives, waitresses, sales people, nurses, bartenders, school teachers, people who *must* be on their feet all swear by them. Joggers, tennis, golf, basketball and racquetball players find they can now play in comfort even with **heel spur** problems. **If not satisfied, return within 10 days for full and prompt refund.**

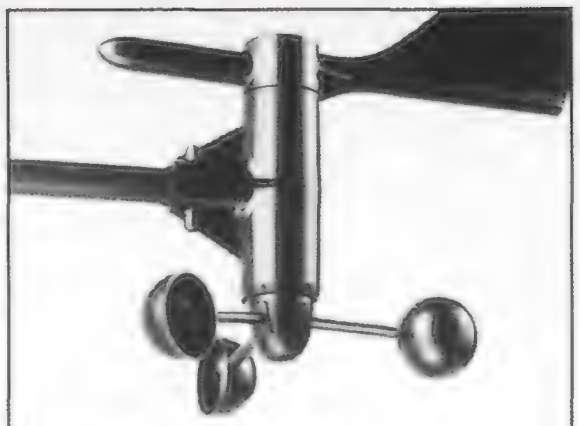
Calderon Products, Inc.
117 Fairlawn Plaza Drive, Dept. 426
P.O. Box 5387, Akron, OH 44313 • (216) 864-8100

☐ One pair Cushi Heel Pillows **$7.50** p.pd.
☐ Save! Two pairs for only **$13.00** p.pd.
☐ Save more! Three pairs for only **$17.25** p.pd.

Fast delivery! Shipped by First Class Mail.

Enclosed: ☐ check ☐ money order ☐ cash
Visa–MasterCard holders (TO ORDER ONLY)
Call Toll Free 1-800-824-7888, Operator 941
24 hrs. a day, 7 days a week.
Ohio residents add 5½% sales tax.

Specify shoe size:
Men's shoe size _____ Women's shoe size _____
Name _____
Address _____
City _____
State _____ Zip _____



PROFESSIONAL QUALITY WEATHER STATION NOW AFFORDABLE ENOUGH FOR HOME USE!

The new WeatherPro weather station uses state-of-the-art technology to give you full monitoring capability at an incredibly low price. The WeatherPro includes a weather computer, remote precision wind direction vane, wind speed sensor, external temperature probe, mounting hardware and 40' of cable-**all for only $179!**

- •WIND SPEED
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- •RAINFALL (OPTIONAL)*
- •WIND GUST
- •WIND CHILL
- •TIME
- •AUTO SCAN
- •1 YEAR WARRANTY
- •14-DAY MONEY-BACK GUARANTEE

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*Automatic-emptying electronic rain gauge-$49.95
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Salen Lindblad expedition cruising gives

See. you our wonderful world, its wildlife, its sea life and its peoples. M.S. Frontier Spirit Inaugural Voyages start November 5, 1990. **Hear.** She has been designed and built expressly for expedition travel. From King Penguins in Antarctic coves to the majesty **Touch.** of New Zealand's Mitre Peak; from thrilling New Guinea tribal music to a sense of wonder as ice formations drift through frozen seas…To embark on a romantic, exciting journey that will be a deeply felt **Feel.** homage to the environment, send the coupon today.

M.S. Frontier Spirit is registered in The Bahamas.

"AN INSPIRING EXPERIENCE FOR THE SENSES"

See your travel agent, or mail this coupon for a full color brochure on *M.S. Frontier Spirit's Inaugural Voyages* to the South Pacific, New Zealand, Tasmania, Antarctica and Australia's Great Barrier Reef.

Name _____
Address _____ SM1
City _____ State _____ Zip _____

SALÉN LINDBLAD CRUISING, INC.
133 E. 55th Street, New York, NY 10022 1-800-223-5688 N.Y. (212) 751-2300

General Sales Agents For
Frontier Cruises
(Bahamas) Ltd

Phenomena, comment and notes

A machine that lets us see the birth of the Universe nears the end of its run; a prairie will be its memorial

Once it was tallgrass prairie mixed with oak savanna. Within a few years it will be again—one of the very few in Illinois, in all of the Midwest. Humans have been busy here for the past 8,500 years, but not until 1830 was the prairie plowed, the trees cut. For the past 15 years it has been the site of one of the great achievements of the human mind.

In the middle of this 6,800-acre tract is a circular berm, a ridge four miles around. Beneath the berm is a tunnel, and inside the tunnel are two metal tubes, one over the other. In the lower tube bunches of protons and antiprotons, each as long as a pencil and as thin as a human hair, plow into each other at nearly the speed of light, releasing energy in trillion-electron-volt bursts. Physicists are using what today is the highest energy accelerator in the world to look for the "top" or "truth" quark, the last of the six quarks they believe are the basic building blocks of matter.

This is Fermilab, the National Accelerator Laboratory, 27 miles west of Chicago in what once was the farming community of Weston. I was there to visit the natural habitat of Jim Trefil, a theoretical physicist who has been writing articles for us since 1974 (not to mention a book or two on the side). He once joined me in my preferred habitat, the Atlantic coast at Chincoteague, Virginia. Now I was on his turf.

Our guide was J. Richie Orr, the associate director for administration, just back from Washington where he and three colleagues had received the

NE

The First Madame Alexander Porcelain Christmas Doll Ever Issued!

Doll approximately 12" high.

© 1989 NECS

NÖEL

Edition limited to 5000 hand-serially numbered dolls.

Hand-made, hand-painted and entirely hand-tailored in the U.S.A.

- Fine imported *porcelain* sculpted head, arms and legs. First such Madame Alexander Christmas doll ever!
- Unparalleled hand-craftsmanship and hand-tailoring. Even her coiffure is individually styled!
- Exceptionally sumptuous materials: authentic satin, organdy, fine lace and rich, elegant velvet.
- Exclusively commissioned by The New England Collectors Society. *Not sold in stores.* Convenient acquisition plan.

Madame Alexander is one of the great names in doll-making history. Her fabulous creations are prized by collectors, and lovingly handed-on from mother to daughter. For generations, she has created the dolls that little girls dream about...

Made from an original Madame Alexander mold, "Nöel's" delicate features and enchanting expression are beautifully painted by hand.

You'll be astonished by the sheer luxury of her genuine organdy pleated blouse complete with rhinestone buttons and her satin-lined, red velvet skirt...amazed by the fine hand-work in even the tiniest details: embroidery, ribbon and lace. With hand-sewn bloomers and an old fashioned satin petticoat, here is a doll like none that you've ever seen before...

Your Limited Edition "Nöel" will be serially numbered by hand and will carry the Madame Alexander signature and the hallmark of the New England Collectors Society. Each doll will be accompanied by a doll stand and a Certificate Registration bearing the Madame Alexander signature. She will arrive in a classic Madame Alexander doll box. Reserve your "Nöel" today!

Note the wealth of attention to detail on this exquisite doll.

The New England Collectors Society is a division of Reed & Barton Silversmiths, established in 1824.

NE **The New England Collectors Society**
237 Saw Mill Road, P.O. Box 414
West Haven, CT 06516

MP0010

☐ Check here if you would like to charge each monthly installment to your:

☐ MasterCard ☐ VISA ☐ American Express

Please enter my order for the First Madame Alexander Porcelain Christmas Doll, "Nöel" exclusively commissioned by the New England Collectors Society in a Limited Edition of 5000 hand-serially numbered dolls.

I understand I need send no money now. I will pay for my doll in 5 equal monthly installments of $49.50* each. The first 2 installments will be billed prior to shipment, the balance will be due monthly after shipment. A doll stand will be included at no additional cost. My doll will arrive in a classic Madame Alexander doll box and I will receive a Certificate of Registration bearing the Madame Alexander signature, attesting to this Limited Edition.

Card # _____ Exp. _____

Signature _____
All applications are subject to acceptance

NAME _____

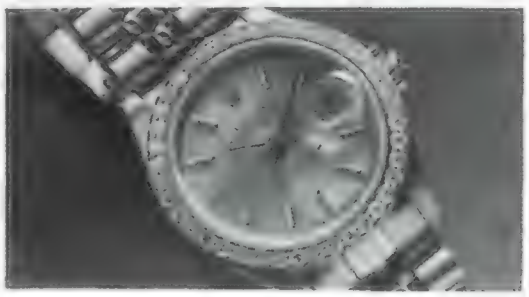
ADDRESS _____

CITY _____ STATE _____ ZIP _____

*Plus $1.50 per installment for shipping and handling. CT and CA residents will be invoiced to include state and local taxes. Please allow 8 - 12 weeks after first 2 payments for shipment. This doll will be available for shipment in March 1990.

The 11th Commandment

Thou Shalt Not Pay Retail!



Ladies Rolex S.S./18kt. with custom Diamond Bezel
Retail $6,800 Grafstein $4,090

Save up to 60% with America's Foremost Fine Watch Discounter

All famous brands including
Rolex Patek-Philippe Audemars
Omega Cartier Ebel Chopard
Sales · Service · Accessories
New · Pre-Owned

Diamonds · Pearls · Estate Jewelry

Call today for complimentary shop-at-home brochure or showroom appt. No sales tax to out-of-state buyers

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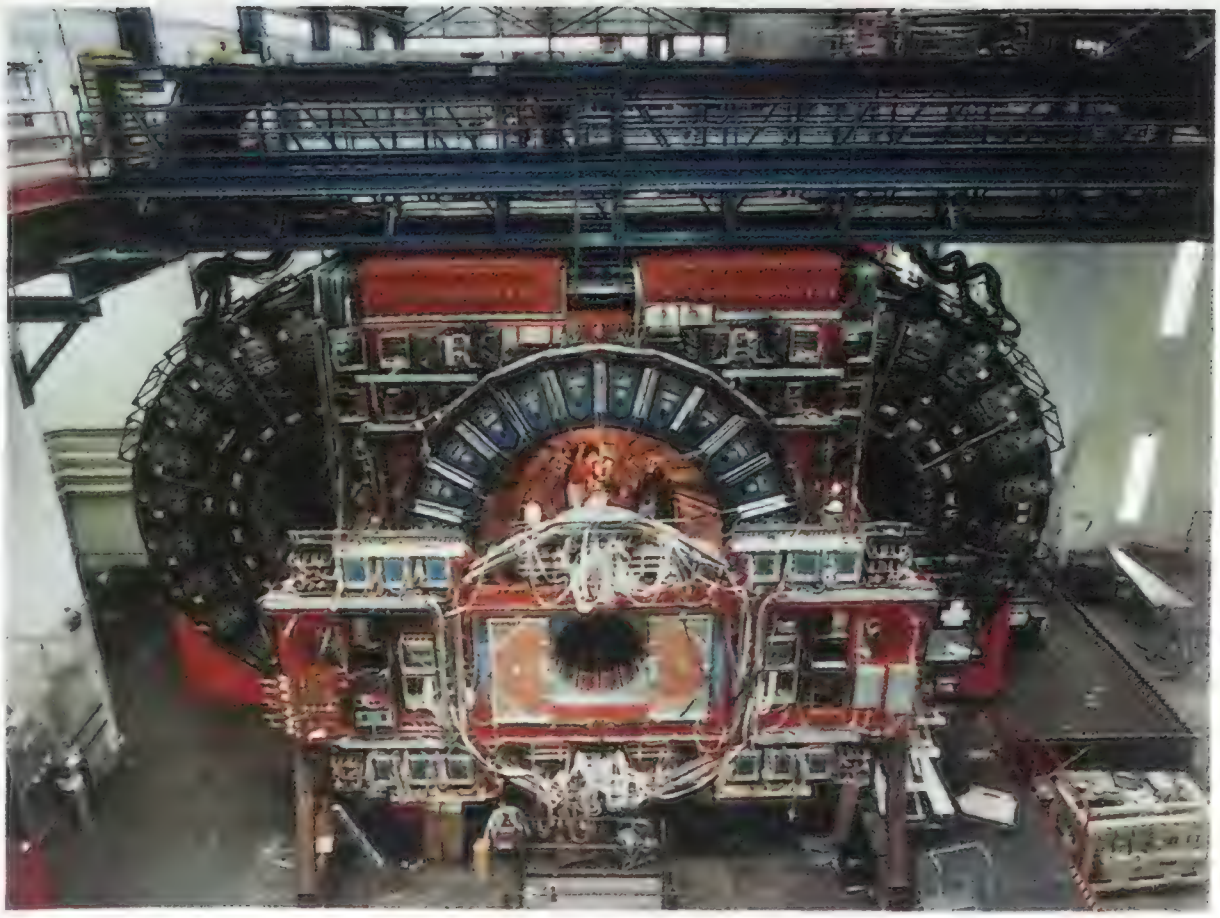

The collider detector at Fermilab, a three-story, 4,500-ton aggregation of sophisticated electronics, is pulled apart for repair and upgrading.

National Medal of Technology. Orr led the team that devised—with their hands as well as their heads—the innovation that doubled the energy levels the Fermi accelerator was originally designed for. Orr's team figured out how to pull the wire and wrap the coils for 1,000 superconducting magnets that make up the new ring through the tunnel.

Accelerators work because subatomic particles with an electric charge, positive or negative, respond to magnetic fields. As the particles race around the ring, more and more electricity is pulsed through the magnets, kicking the particles harder and harder.

The faster the particles go, the more energy it takes to control them, to keep them in a usable beam. Any moving object tends to go in a straight line; that is why the passenger is pushed against the right-hand door in a car turning sharply to the left. In a circular accelerator like Fermilab, the particles are constantly being turned; it takes huge amounts of energy to bend the beam. The lab was paying $16 million a year just for electricity.

In the original ring at Fermilab, a thousand conventional magnets keep the beam in place. Energies of 400 billion electron volts are achieved. But in superconducting materials electrical resistance drops to zero. Magnets made of such materials can produce and control much stronger beams for a fraction of the electricity. The new ring produces energies in the trillion-electron-volt range.

Orr led us along the same path an unsuspecting proton would follow. The process begins inside a Cockcroft-Walton generator, where electrons are added to electrically neutral hydrogen atoms, giving them a negative charge. They come out at the speed of sound. Next they enter a 500-foot-long linear accelerator, where radio frequency waves oscillating through 290 electrodes further accelerate the particles and strip them of their electrons, leaving only positively charged protons moving at a substantial fraction of the speed of light. The rig is powered by a 5-million-watt amplifier (a device my rock-musician son would kill for).

The protons next find themselves in a circular accelerator, where still more energy is added, and then they are injected into the four-mile tunnel, in the upper, original, ring. They are accelerated still further, then dropped down into the new, superconducting ring. At first the protons are in bunches the length and width of a pencil. Each bunch contains about 10 billion protons, which sounds like a lot but is really almost empty; normal matter would have more like 100 trillion billion protons in the same space.

Some of the beam is diverted into targets that produce antimatter, specifically antiprotons. These are accumulated in a small storage ring; after about four hours, enough have been collected for the real business to begin. The bunches of protons in the superconducting ring are pulled tight so

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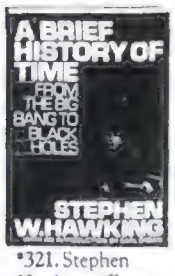

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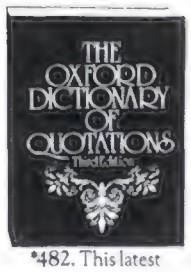

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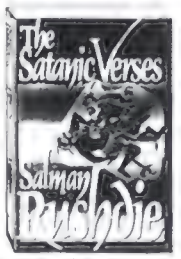

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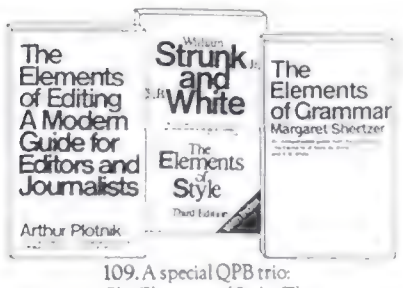
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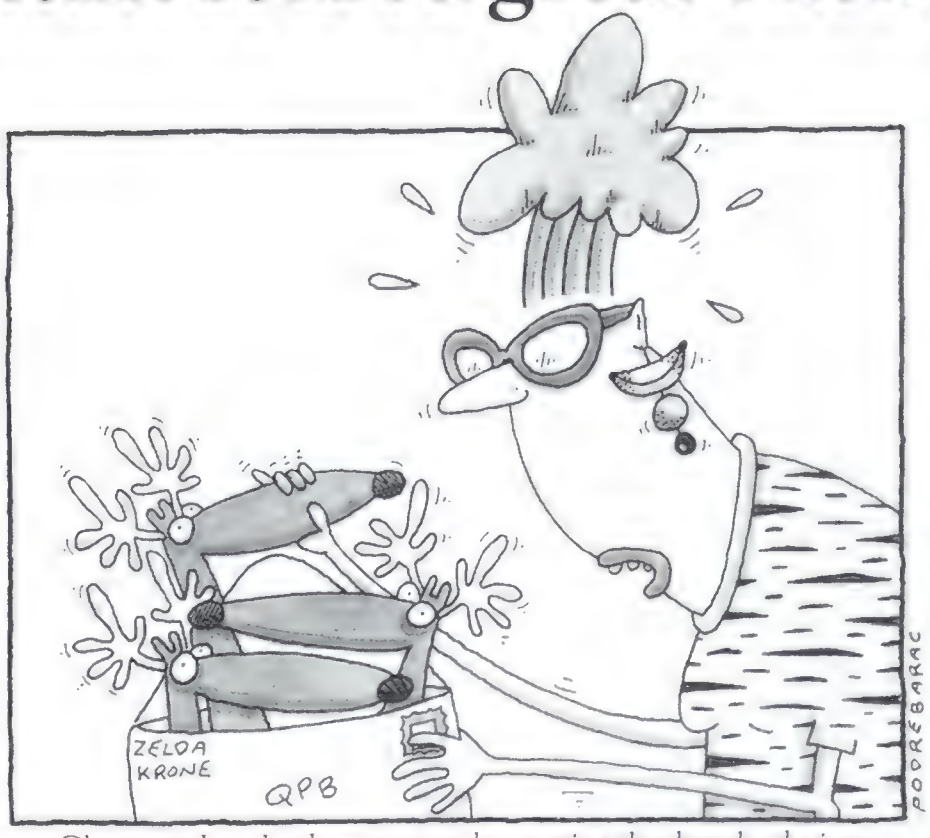

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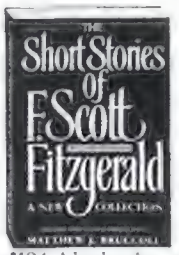

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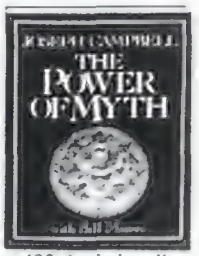

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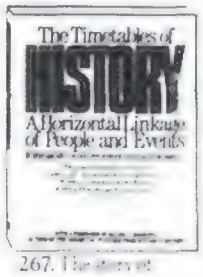

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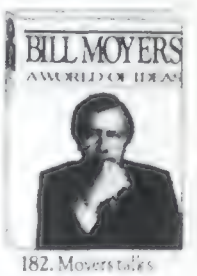

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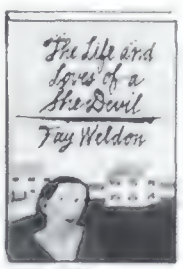

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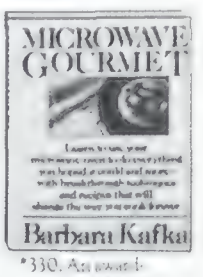

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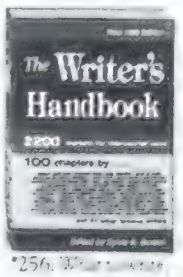

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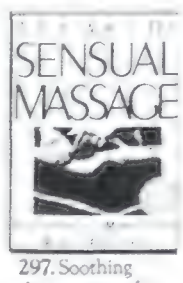

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they are the thickness of a human hair. Bunches of antiprotons are injected into the upper ring, accelerated, then dropped into the lower ring, traveling in the opposite direction. There are three bunches of each, separated by 120 degrees. The two sets are now accelerated to a trillion electron volts and steered into each other.

For the physicists sitting in a cramped control room, watching the action on 60 different screens, the trick is not just to have the beams collide but to have the collisions occur in the exact center of huge detectors (p. 34). They occur 50,000 times a second, and it takes three floors of computers to sort out what is happening. The collisions create, for a very brief time and in a very small space, conditions that existed early in the formation of the Universe, as early as one ten-trillionth of a second after the Big Bang. "We are seeing matter in a form we have never been able to see before," Orr explained. "We create a hot, early stage, and then watch it cool."

On top of the ground, high-energy biologists are also engaging in time travel. They are restoring the tallgrass prairie that once covered this land from horizon to horizon. Since the Nature Conservancy helped them initiate the project in 1975, they have been collecting seeds from the nearly extinct plants that once grew in such profusion, finding them in undisturbed cemeteries and along railroad rights-of-way, and planting them inside the ring.

Slowly, like Brigadoon appearing from the Scottish mist, a prairie is taking form. Robert Betz of Northeastern Illinois University, the guiding force of the project, led us through the bluestem grass and the compass plants, the indigo and the prairie dock. His co-workers have restored 700 acres so far, he said, and are still adding two or three species a year to the mix. It takes at least three years for a new section to build up enough fuel for the fires essential to restoring a true prairie. They hope to reach at least 2,200 acres, although Betz concedes it would probably take many more to approach a true ecosystem. Some organisms aren't waiting: seven pairs of red-tailed hawks now nest at Fermilab.

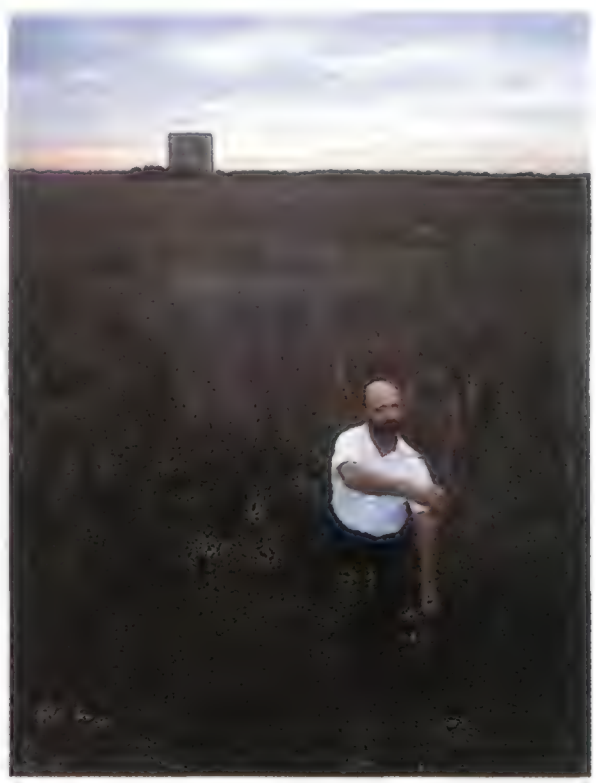
The prairie rather than physics may be the future of the site. As part of his tour, Orr led us through the shops where the superconducting magnets were built and are repaired. In one room we were confronted with a 57-foot-long red cylinder, looking something like a huge torpedo, that had the letters "SSC" painted on the side. It was a prototype magnet for the Superconducting Super Collider now being planned for a site in Texas (see *Smithsonian horizons*, page 14). The SSC is the next generation in accelerators, so big that a ring the size of Fermilab's will be used as an injector.

Orr has mixed feelings about his shops being used to build magnets for the machine that will put his out of business, about the Fermilab beam being used to test detectors for Texas. He talks, not quite seriously, about retiring, perhaps to teach. But the succession of larger and larger machines is the nature of the business.

In its present configuration, Orr estimates, the big accelerator can do useful research for another five years. If the lab gets the money for a new injector ring, so that instead of having 3 bunches of protons collide with 3 bunches of antiprotons there can be 32 hitting 32, then there will be ten more years of productive work. But eventually it will be history, and the exploring will be done in Texas or elsewhere.

What will be left, both Orr and Betz hope, is prairie. Ecologists, like physicists, have to know what *was* if they are to understand what *is*. The prairie as much as the four-mile ring will be permanent testimony to what the human mind can achieve.

John P. Wiley jr.



Robert Betz checks growth on restored plot inside Fermilab accelerator ring.

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By Douglas Preston

Following—painfully—the route of Coronado after 450 years

A writer and photographer, neither expert on horseback, cross 950 miles of some of the toughest terrain in the Southwest

We finally laid eyes on Hawikuh, the first of the Seven Cities of Gold, on May 23, 1989. We were sitting in plastic chairs in front of a Zuni shepherd's cabin, drinking coffee by the glow of a kerosene lantern. The shepherd, Lincoln Harker, had snapped on a transistor radio—our arrival being a festive occasion—and we were listening to the Doors. The music crackled and hissed, as if coming to us from a vast distance.

We were facing east, looking out over an empty plain rimmed by mesas. The sharp cooling of the air brought a gunpowdery smell of dust into our nostrils.

We told Lincoln that we were following the route of the Spanish explorer Coronado on his search for the Seven Cities of Gold. Tomorrow, we said, we hoped to reach Hawikuh. He listened, head sunk on chest, cupping his coffee mug in both hands. When we finished he leaned his chair against the cabin with a thump and pointed into the dark.

"That is Hawikuh," he said.

That's when we saw it: an unnaturally barren patch of ground on the shoulder of a hill.

We had started our journey six weeks and 600 miles before. Our plan had been to follow, on horseback, part of the route that Francisco Vásquez de Coronado and his army took in 1540, while looking for the Seven

Acoma Pueblo, shimmering like a city of gold in a New Mexico sunset, is still very much inhabited. Probably because of its powerful defensive site, Coronado did not attempt to conquer this community.

Cities of Gold. We would ride cross-country, not following roads or trails, and would camp in the desert, much as Coronado and his men did 450 years ago. We would pack our food—mostly flour, beans and rice—on horseback, and find water and grass where we could. Our only concession to the modern age was a set of 175 U.S. Geological Survey topographical maps on which we had plotted our route.

Coronado's expedition was one of the most remarkable, and in some ways one of the most absurd, in the annals of exploration. In 1539 a friar named Marcos de Niza returned to Mexico City with a story that electrified the New World. Far to the north he had discovered "the greatest thing in the world"—a city, "larger than the city of Mexico," with buildings up to ten stories high. The surrounding kingdom, called Cibola, was the "best and greatest that had ever been heard of" and consisted of seven equally magnificent cities. Fray Marcos had hastened back to New Spain with the news, and soon everyone was talking about the Seven Cities of Gold. It was another Inca or Aztec empire, waiting to be conquered.

The Viceroy of New Spain awarded the plum job of conquest to the rising young nobleman Francisco Vásquez de Coronado, who quickly assembled a great army of nearly 1,500 men as well as slaves, more than 1,000 horses, and herds of sheep and cattle. Most of the men were in their teens and 20s. Coronado himself was scarcely 30 years old.

This army departed Compostela in February 1540. The Spaniards reached Caliacan around Easter. Coronado then went ahead with 100 lightly equipped men and Fray Marcos as the guide. In late May, Coronado and his advance guard finally entered what is now the United States, in southeastern Arizona. The discovery of the Southwest had begun.

We planned to follow Coronado's route from where he crossed into the United States to the ruins of Pecos Pueblo (now the Pecos National Monument)—a ground distance of about 950 miles. Our journey would traverse some of the wildest and most spectacular desert and mountain country in the West—country so remote that it had changed little since Coronado's day. Although we were no admirers of Coronado, we hoped we might be able to recapture, in a small way, what the original discovery of the Southwest might have been like.

In mid-April, we set off at the Arizona-Mexico border, where the San Pedro River entered the United

Photographs by Walter W. Nelson

Map traces the author's route through Arizona and New Mexico. Coronado's actual path is not known for certain; scholars have proposed possible routes, both eastern and western variations, as indicated.

States, flowing under a five-strand barbed-wire fence. The river was low—little more than a braided stream sliding over a buckskin-colored bed of sand. Unbeknownst to us, Arizona was edging into one of its worst droughts in half a century.

I knew very little about horses and packing, being (as they say) a damn Yankee from Boston. My partner Walter Nelson, a photographer, knew a little more, having grown up near the Red River in Texas, but both of us were greenhorns of the rankest kind.

The trip started well. After being dropped off we camped a half-mile from the border at a cattle tank brimming with cold water. We went to sleep listening to the clanking, sucking, trilling sound of an old windmill, which reminded me of some Rube Goldberg contraption running on high.

When we woke at 4:45, my bedroll was crackling with hoarfrost. The sun rose at 6 and by 9:50 the temperature was close to 100 degrees, having spent all of 40 minutes climbing through the comfort zone. As we saddled up, the cottonwoods suddenly loosed their cotton, which swirled about us like snow.

Our high spirits did not last long. The brush and deadfall along the river stopped us cold, while the river bottom itself shivered with quicksand. The lead rope of my packhorse wedged up under my riding horse's tail, and I was bucked halfway across the river. Hoping that the floodplain might be easier, we struggled up a steep cutbank and forced our way through a thicket of mesquite to an immense field of yellow grass that was as tall as our horses' eyes. Almost immediately my horse tumbled into a five-foot-deep hole. I leapt off and the animal clambered out, badly frightened but unhurt. We dismounted and led our horses, sometimes having to feel our way along, as the field was riddled with treacherous holes rendered invisible by the blinding sun and grass.

In less than an hour we had to stop and repack our loads twice. Packing a horse properly is an operation that requires great skill and painstaking care, as well as powerful lungs and an inexhaustible supply of curses. It would take us weeks to master this delicate art.

We camped that night back down by the river. In a hard day's riding we had barely covered three and a half miles. As I lay in my bedroll, scratched, sore and hungry, two thoughts ran through my mind. The first was that we were going to be lucky to average 12 miles a day, and as a consequence the trip would take ten weeks or more, not the four to six I had estimated. The second was that our chances of finishing this trip without killing ourselves and our horses seemed slim indeed. The problem was that Walter and I had already spent $8,000 of other people's money to make this trip; we simply could not quit.

I was terrified.

That night illegal aliens came up the river, pursued by the Border Patrol, and two of Walter's horses broke their hobbles and went galloping off in the dark. I huddled in my bag, pretending to be asleep while Walter hunted them down.

For its first 35 miles, the San Pedro flows through a wilderness of quicksand, cactus, cutbanks, sudden arroyos and brutal mesquite. We had to wear chaps and our heaviest clothing in the 100-degree heat, and every evening our horses' legs and our faces were scored and bloody from the mesquite thorns.

For the first few days, Walter, who was as grizzled a Texan as you will find, complained about my appearance, saying that with my new hat and sunglasses I looked like a "dern New Yorker on vacation." When we made camp on the fifth day, he came over and peered into my face. "You sure don't look green anymore," he said, "you're the dirtiest s.o.b. I think I've ever seen," and went off laughing. It was a badge of honor I would, unfortunately, wear for the rest of the trip.

We rode through landscapes of almost surreal beauty. Once we stopped for lunch in a deep stand of cottonwood and surprised a nesting colony of great blue herons; they circled and cried over our heads. Later we flushed a family of javelinas and sent them snorting and grunting into a field of tumbleweed.

Douglas Preston, who wrote about Southwestern adobe architecture in the November issue, is at work on a book about retracing Coronado's steps.

Other images are imprinted on my mind: blood-red arroyos slicing through curtains of green mesquite; distant blue mountains seen through a screen of cottonwood; an antelope bounding through grass as white as snow. Every evening, while the crowns of the trees filled with golden light, Walter and I would whoop and roll about in the shallow river, letting the cool water wash off the dust and sweat of the day. Every morning we rose in the freezing dark, and lit a fire to thaw ourselves out and make "cowboy" coffee. (Recipe: Three fistfuls of grounds in pot of bad water. Boil like hell until mixture is opaque and soupy. Drink or eat with spoon.)

Before the trip, we had worried about getting saddlesore. Oddly enough, after five days everything *but* our rear ends began to hurt. On the first day, one of Walter's horses had stepped on my little toe, breaking it. It had swollen up like a Vienna sausage, and then I had left my cowboy boots in the sun for a few hours while taking a nap, shrinking them dreadfully. Wedging the broken toe into the front of the tight boot every morning became a perfect agony.

We spent most of our day, it seemed, tying and untying knots as hard as teak and gripping ropes leading to recalcitrant horses. Once I counted eight scabs, cuts and rope burns on my right hand and 14 on my left. In addition, all ten fingernails had either been ripped or chipped down to the quick.

Fortunately, in our medicine chest we found a tube of a substance called Bag Balm. Billed as an "Antiseptic Emollient Treatment for Horses & Cattle, Other Livestock, Small Animals," this marvelous embrocation was for "Hoofs, Body & Legs, Udder & Teats." It was also ideal for sore hands and butts. During the course of our journey we went through three large tubes of the stuff, very little of which was applied to the horses.

On the eighth day, I saw, across the river, the end of a dirt track leading into the little town of St. David. I nearly wept; a road never looked so good. In my eagerness to reach it I mired one of my horses, but managed to free it in a frenzy of shouting, amid flying clots of black mud. When we finally entered St. David, somebody called the police.

For years, scholars have argued about where Coronado traveled in Arizona. Two broad possibilities have been proposed: a western route up through east-central Arizona and an eastern route that roughly follows the modern Arizona-New Mexico border northward. For both the western and eastern route, two major alternatives have been suggested. We had chosen to follow the western route and to retrace, at least in part, its two possible trails (see map opposite).

An 1898 Frederic Remington illustration depicts Coronado's men trekking across Southwestern desert. The Spanish soldiers did not travel light: they brought herds of cattle, sheep and pigs along for rations.

We therefore left the river 15 miles above St. David and headed into the desert, following the western subroute most favored by experts on the Coronado period. Several days of riding brought us into a high, lonely country called the Mesas, lying between two rugged mountain chains. All mesquite and cactus vanished, leaving nothing but rolling grassy hills the color and texture of fine chamois. Later we saw a vast herd of black-tailed deer, hundreds of them covering an entire hillside, rippling and flowing like water.

Then we swung northwest to intercept the Gila River and rejoined the other major western route. Beyond the Gila the mountains began in earnest, wave after wave of them, finally culminating in the Mogollon Rim. By the time Coronado and his advance guard reached this point, they had begun to suspect that something was amiss. The good friar's glowing descriptions of the countryside—the fine pastures, flowing waters and easy trails—did not correspond to the cactus-choked plains, crack-bottomed arroyos and savage mountains they were struggling through.

We would soon be entering what the expedition chroniclers termed the great *despoblado*—a word denoting an "uninhabited area" but implying something more akin to a desolate wilderness. This was the mountainous country leading up to and beyond the Mogollon Rim, a high escarpment that stretches from western New Mexico nearly halfway across Arizona.

While passing through Globe, Arizona, we met a horseman named Mark Shellenberger, who put us up for the night and mapped out for us an alternative to the route we had planned. His route would shave 50 miles off our trip and, he pointed out, had the distinct advantage of not killing us in the process.

Beginning the climb to the Mogollon Rim

We got our first glimpse of the Salt River on May 9, nearly a month into the trip: a shining loop of water curling through a deep gorge. Beyond rose layer upon layer of blue mountains as far as the eye could see—the heart of the great despoblado. We guessed that the farthest blue line must be the Rim itself; later we would realize it was merely Board Tree Saddle, not even halfway across Rim country. Gazing over this restless sea of mountains, I felt a shiver creep up my spine.

We camped next to the river. While bathing, I was surprised by a thin, ragged man with long hair and an enormous black beard. He wanted to know what the hell I was doing in his swimming hole. "You seen any rattlers?" he added. I said no. "Good," he said, and poked his stick through some old roots and weeds around the pool. When he was satisfied there were no snakes, he went for a dip.

San Pedro River, where the author's expedition began, was at a low ebb at onset of a severe drought.

The author leads a packhorse through a tricky spot in the trackless thorn scrub east of the San Pedro.

Riders had to avoid quicksand in riverbed and fight their way through brush, deadfall, along the banks.

The going is no easier approaching a hogback ridge on the way to Mogollon Rim and the Colorado Plateau.

His name was Rod, and he told me he'd been shot up in Vietnam and lived in a tent a quarter-mile upriver. He said he didn't "mix too good with civilization" and that he hunted rattlesnakes for a living, making hatbands and belts from their skins. I had never met a man so terrified of rattlesnakes. "Someday they're gonna git me," he said, "I've killed too many now." That evening, he came to dinner carrying a mess of catfish. Up to that point our breakfasts, lunches and dinners had consisted of what we called the Coronado Plan: boiled oatmeal in the morning; nuts and dried fruit for lunch; and a single pot of beans, rice and quinoa (a grain grown by the Incas, high in protein) with biscuits on the side, for dinner. We stuffed ourselves with such vehemence on the greasy fried catfish that Rod asked us if we were all right.

Danger below, terror on the ledge

The next day Rod showed us a place to ford, hollering directions from the bank. The Salt, even at its low state because of the drought, was full of deep channels and sudden holes that would drown our packhorses (a packed horse will sink like a stone).

The ascent of the hogback ridge was the most frightening journey of our trip, through steep rocks and plunging cliffs choked with loose rock, cholla, yucca and saguaro cactus. High up on the ridge, with Walter leading, we rounded a shoulder. Walter stopped, and in an unnaturally calm voice he told me to turn around and go back. The trail ended in a chasm and his two horses were standing on a narrow ledge; with a sudden chill I realized that Walter was trapped. I did not see how he could possibly turn both his horses around. He couldn't even dismount, as that would simply have carried him over the side of the cliff.

There was a long silence. "Okay, horses, go!" he said and turned the reins into empty space. I looked away, but when the expected whinny and crash of falling horses did not occur, I turned back. Walter was riding toward me with a big grin. "Just gotta trust 'em," he said, patting his horse Pedernal.

We stopped for lunch near the top, exhausted and shaking from stress. The horses were in a similar state and we spent 15 minutes pulling cactus spines out of their legs. From where we were, we could see the Salt River crawling through its gorge 1,000 feet below us, shut in by sheer cliffs on all sides. "Somehow," I said, "I don't think Coronado rode down that river." The disputed portion of Coronado's western trail ends near the junction of the Little Colorado and Zuni rivers, about 250 miles from where we stood at the Salt. At the Little Colorado we would pick up his actual trail again and ride it for the next 350 miles to Pecos.

We made slow progress through the Rim country.

Doug Preston takes a welcome birthday plunge in a concrete water tank, part of an irrigation system.

Robin Sachs

Photographer Walter Nelson stirs the usual oatmeal breakfast at the edge of El Malpais, the Bad Country.

As we gained altitude, the mountainous desert gave way to a deep pine forest, filled with dripping ferns. One morning I climbed a hill to look for a missing horse. At the top the clouds suddenly parted, and there, rising like a 1,000-foot wall, was the Rim itself, covered with a layer of fresh, sparkling snow.

The Mogollon Rim marks the southern boundary of the vast Colorado Plateau. As we pushed northeast, the pines and lush grass gave way to cedars, and then we rode into vast treeless immensities of sagebrush, red rimrock and blue sky. Below the Rim it had taken a supreme effort just to make ten miles in a day; now we would easily log 20 or 25.

In late May we hit the junction of the Little Colorado and Zuni rivers, some 60 miles from the Seven Cities of Gold, and camped at the base of the Stinking Springs Mountains. We cooked by burning cow chips, and the water in our canteens got so hot in the blazing sun that it seared our lips when we drank. One night I woke suddenly and found myself staring into a boundless pasture of stars; for a moment I panicked, thinking I was falling upward into space.

Early in the trip we had realized that if our horses were to survive, we had to take better care of them than we did of ourselves. By this time everything revolved around the horses. The horses determined our route, where we camped, where we stopped for lunch and sometimes whether we went anywhere at all. As the horses lost weight, we became obsessed with finding them good grazing. Even so, the grazing was usually so sparse that we had to hobble the horses, to allow them to wander far and wide looking for grass. They would often travel two or three miles during the night, and we would have to spend hours tracking them the next morning. We would then ride them bareback into camp, singing at the top of our lungs.

Close encounter of the lethal kind

Somewhere east of the Stinking Springs Mountains the Spanish first encountered the Zuni: from the top of a mesa, two Indians appeared and vanished. The next day, a group of Indians gathered above the Spanish camp and hollered and shouted, so startling the men that, in their panic, many saddled their horses backward. A day later, Coronado's haggard party topped a low rise and found themselves gazing on the first of the legendary Seven Cities of Gold.

One of the soldiers would later recall that moment: "Such were the curses that some hurled at Fray Marcos," he wrote, "that I pray God may protect him from them." Instead of a magnificent, shining city-fortress, the disappointed men saw only "a little, crowded village, looking as if it had been crumpled all up together." It was the Zuni Indian village of Hawikuh.

Water was where they found it, including a "scuzzy and yellow" variety in this dirt stock tank on a ranch. Finding sufficient water and fodder for the horses was the first order of business throughout the trip.

They found the province up in arms. The Spanish recited the usual bombastic oration to the effect that if the Indians would merely submit to the "protection" of the king of Spain and take Christ as their savior, they would be unharmed. It is unclear whether the Zuni understood any of this, but at any rate they quickly provided a logical answer: a shower of arrows. The fight lasted barely an hour. With the advantage of harquebuses, crossbows and armor, the Spanish routed the Indians.

But we encountered no Indians—and indeed no human beings—until we crossed the New Mexico border and saw Lincoln Harker standing in the doorway of his sheep camp, his hands raised in greeting. The plain of Hawikuh was empty, the city of gold in ruins. We had decided to break the trip at Zuni and finish in August after the start of the summer rains, when the grazing would be better.

The morning after our arrival at the sheep camp, we set off for Hawikuh. From the top of the ruin we had a sweeping view of the surrounding countryside: a wilderness of buttes, mesas, plains and hard-etched horizons. In the entire landscape there was no sign of human life except a lone Indian shepherd driving a flock of sheep across the plain, a little black dog trotting at his heels. I stretched out and rested my head on a chiseled block of stone. In the distance, I could hear the tinkling of sheep bells and the baaing of sheep, rising and falling on the wind. Then I heard a new sound, a low rumble, and an almost invisible jet left a snowy contrail across a field of blue; the sun turned once across its aluminum skin just before it dipped below the horizon. I covered my face with my hat and drifted off to sleep.

During the months following the defeat of Hawikuh, Coronado settled in at Zuni and sent exploring parties east and west. During this time a delegation of Indians arrived from a powerful pueblo called Pecos, bearing gifts for the "strange people, bold men" they had heard about. Coronado sent one of his captains, a man named Alvarado, back to Pecos with the Indians.

The old Indian trade route from Zuni to Pecos, which Alvarado followed, was the trail we would take (Coronado himself went by a different route later). The first thing we had to do was find three new horses, as the horses I had borrowed for myself for the first part of the trip were no longer available and one of Walter's horses was sick. I decided we should take a

Painfully retracing Coronado's steps

At the end of another day's ride, photographer and writer survey a scene that once confronted Coronado.

Safely around the Malpais lava beds, one of the horses grazes peacefully on the Zuni-Acoma trail.

Spanish Barb along. This is the breed that many feel may have been the "horse of the Conquest," the horse that Coronado used.

Luckily, one of the top breeders of these horses was located in Santa Fe. I telephoned and asked if I could borrow one. After the initial shock wore off, they decided to lend me their prize brood mare—a magnificent dun. The horse was worth $10,000, being the last breeding mare in a famous Barb bloodline. Her name was Engwahela.

One of the stable's owners, Roeliff Annon, explained why they lent me the horse. "We are working to restore the horse of the Conquest. We'd made a lot of claims for what this breed could do, and I thought this was a good opportunity to put some of these claims to the test." I also bought a dirty-white Appaloosa named Wilbur, and a chestnut quarter horse named Redbone.

We resumed the trip in early August. A friend at Zuni, Edward Wemytewa, invited us to set up camp on his land. We rode out of Zuni on August 7 and almost immediately ran into trouble. The first night we camped behind Dowa Y'alanne, the sacred mesa of the Zuni, in a small meadow ringed by deep arroyos and badlands. The camp had no water, but we expected to find some the next morning. That night, in an unac-

On the high mesa on the horizon at right is the Acoma Pueblo, which the explorer hoped was a city of gold.

Robin Sachs

countable lapse of judgment, we let Engwahela graze free, expecting that she would not leave the three geldings. The next morning she was gone. "She can't be far," Walter said cheerfully as he set off following her tracks. "Make me a good breakfast."

I waited. The sun climbed in the sky and the heat became nearly intolerable. By noon I realized that I had better water the other horses, so I saddled up Redbone and prepared to take them to a hidden spring about four miles from our camp. I wrapped our last canteen around the saddle horn, and put up Redbone's reins for a second to remove Wilbur's hobbles and untie Pedernal.

Suddenly Redbone, who had been standing stock-still for the past four hours, decided to start trotting off, with Wilbur at his heels. I had committed the grievous sin of leaving two horses unguarded, even for a moment. Now I was going to pay for it. Leading Pedernal by his rope, I jogged after them, cooing and whispering about oats and grain and all the wonderful things they would have if they would only stop. They were not impressed. They looked back and broke into a gallop. In a moment of absolute despair, I threw myself on Pedernal bareback, and with only a lead rope to control him jabbed my heels into his flank.

In what can only be termed an explosion, he took off. He raced after his departing friends, leaping arroyos, plunging down banks and dodging piñon trees; in vain I hollered and tried to pull his head around with the lead rope. It was no use. I couldn't stay on him. I went flying, and slammed into a soft bank of dirt. By the time I figured out I wasn't dead and struggled to my feet, the horses were gone—carrying away the last of my water. In the direction they were headed, I figured there were no fences all the way back to Arizona.

I began tracking them, my thirst mounting. After four or five miles, I saw a flash of white in a stand of piñon trees about a mile away. I crept up within several hundred yards, and then filled my hands with dirt, holding them out and whistling as if I had a handful of oats. Pedernal jerked his head up and immediately took off at a gallop, with the other horses following. I followed them for hours in the blinding heat, but they wouldn't let me get nearer than several hundred yards. The horses eventually entered a country of badlands west of Dowa Y'alanne, and I caught them when they stopped to drink at a mudhole.

Walter and Engwahela finally arrived at the camp late in the afternoon. He had walked back to the

Typical of the rugged country that is the Zuni sacred preserve is this mesa near Dowa Y'alanne. Its Indian name is Shundek'yay'a-dahna, which loosely translates as Moisture (or Greenery) Point.

pueblo, where he had enlisted Edward's help in tracking the horse. Walter had been tracking her on foot about 16 miles from our camp, carrying a bucket of oats, when the horse came up from behind and nudged him with her muzzle.

A week of riding brought us past El Morro and across the Zuni Mountains to the western edge of El Malpais, the Bad Country: a vast basin filled with black, twisted lava. Many Coronado scholars have assumed that Alvarado and his Pecos guides went around the Malpais. No horse or mule, they say, could have crossed it; and besides, they claimed, there was no water in the lava beds.

I did not agree. I thought it unlikely that the Indians leading Alvarado would have taken a 30-mile detour just to avoid a little rough, waterless country. I wanted to prove a horse could be ridden across the Malpais.

We started into the lava the morning of August 13. We had chosen to cross at a seven-mile stretch that the National Park Service had indicated was the Dominguez-Escalante Trail, an old Spanish route. In a half-mile we found ourselves in the midst of the strangest landscape in North America, surrounded by great rafts and blocks of black lava. We decided to scout ahead on foot.

Walter volunteered, and returned an hour later, his face white. "That's the closest I've ever come to seeing hell itself," he said, gasping. The bottoms and sides of his boots were scored by the lava, and his hands were cut. We turned back.

We rode along the edge of the Malpais and that evening came to a ranch house. The rancher, a man named Alfredo Mirabal, listened to our story. "That ain't the Dominguez-Escalante Trail," he said, laughing. "That's just something made up by the park people. That ain't even a trail at all. The *real* trail, the old Indian trail, starts right here on my property. They wanted to mark it but I told 'em to get the hell out."

We got into his four-by-four pickup and bumped across the prairie alongside the black wall of lava, and he showed us the trailhead. It was so well hidden that I didn't see it until I was five feet from it. It was just wide enough for a horse, and it was clearly man-made.

"The Indians used to escape from the cavalry in there," Alfredo said. "The cavalry could only follow 'em one horse at a time, and the Indians would just

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Steps lead up Inscription Rock, El Morro National Monument, where Indians, Spaniards, left their marks.

pick 'em off." When I asked about water, he snorted. "There's more water in that Malpais than anywhere else around here. You just gotta know where to find it." He then showed us yet another trail across the lava, closer to where we had decided to camp. This trail, which we crossed the next day, was so wide and flat you could have driven a jeep along it.

The distance from Acoma to Albuquerque was about 75 miles. In 60 of those miles we found water in only two places: a chocolate-milk-like substance in a mud wallow and a green scummy brew in an abandoned sheep corral. On the third day, with our supply running out again, we saw a windmill and cattle tank in the distance. Cattle were clustered around it, meaning there had to be water. We broke into a gallop. I arrived first, to find a beautiful tank brimming with water. When I rode around it, my horse suddenly shied away. There, lying mostly submerged in the water trough, was a cow whose head had been partly blown away by a very recent shotgun blast (this method of settling disputes is common in these parts).

"We can't drink this water," I said.

Walter got off his horse and peered at the cow. The cow's eyes rolled and her legs trembled. He looked back at me. "I don't know why not, the cow ain't dead yet."

"You have a point there," I said, and we proceeded to fill up our canteens. We would drink that water all the way to Albuquerque.

Every day the hot blue outline of Sandia Crest had been rising a little higher over the horizon, and every night the glow of Albuquerque became stronger. On the fourth day we came to the edge of an escarpment. Spread out below us in the broad valley along the Rio Grande was Albuquerque itself, cloaked in a pool of brown smog. We wound our way to the edge of the metropolis through piles of garbage, burned mattresses, discarded refrigerators and dead animals, and then rode straight down a busy avenue into the heart of the city.

Alvarado and his guides probably struck the Rio Grande very close to this spot. What he saw were emerald fields unfurling along the floodplains of the river, and dozens of large, prosperous pueblos lining the terraces above the riverbanks, a "kingdom" the Indians called Tiguex (present-day Keresan). Alvarado sent back word to Coronado that this rich valley would be a good place for the army to spend the winter. He continued up the river and then went east at Galisteo Creek.

Seventy miles up the Rio Grande we rode into Santo Domingo Pueblo, at the confluence of Galisteo Creek. We were given a warm welcome by pueblo governor Ernie Lovato, a short man with a powerful chest and a rapid, intense way of talking, who fed us a splendid traditional dinner of mutton stew and Indian bread. "Many centuries ago," he pointed out, "we greeted Coronado the same way. There is a deep tradition of hospitality among the Santo Domingo people. I hope," he continued with a wry smile, "that you do not return our hospitality the way Coronado did."

Alvarado arrived at Pecos in late September. The powerful pueblo sat on a tongue of rock in the middle of a green valley, with the Sangre de Cristo Mountains rising up behind it. The Indians streamed out and greeted Alvarado with skirling bone flageolots and beating drums, and loaded him down with woven blankets, buttery-soft animal skins, turkeys, jerked beef and rich turquoises. The Pecos were "feared throughout that country," one Spanish soldier wrote; and they "boast that no one has been able to conquer them."

Eating from silver, drinking from gold

Here, at Pecos Pueblo, the ultimate fate of Coronado's expedition was sealed. Incessantly inquiring after gold, Alvarado came across a fast-talking Plains Indian slave at the pueblo, whom they nicknamed the Turk. The Turk spun a marvelous story about a kingdom called Quivira. Why, said the Turk, in Quivira everyone ate from plates of silver and drank from jugs of gold, while the king napped under a tree festooned with gold bells that tinkled in the wind.

Once again the Spanish felt the fever of gold upon them, and decided to seek Quivira the following spring. Meanwhile, Coronado and his army had arrived at the Rio Grande for the winter. In return for the hospitality of the Tiguex Indians, who had wel-

comed the Spanish with gifts and food, the Spanish seized a pueblo and went around confiscating clothing and blankets. One pueblo revolted, but when the Indians surrendered under a promise of clemency the Spanish burned them at the stake anyway. Other pueblos rose up, and by spring much of the green Rio Grande valley had been laid waste by the conquerors.

The following April the army decamped and went in search of Quivira, venturing 1,000 miles into the Texas Panhandle. Coronado and a handful of men pushed on as far as central Kansas, where they entered the legendary kingdom: it consisted of a few dozen straw huts along the Arkansas River. The Turk was promptly garroted and Coronado returned with his army to Mexico, his expedition a failure, his fortune gone and his reputation destroyed. He died in obscurity at age 44.

Without a calendar, we had lost track of the days, and I am still not sure exactly when we finally rode into Pecos Pueblo, our final destination. It was nearly September, and the nights had already begun sharply cooling off. As we rode into the parking lot of the Pecos National Monument, thunderheads piled up over the Sangre de Cristo Mountains, sending down gunmetal-blue columns of rain. The great pueblo, where Alvarado had been greeted by flutes and drums, lay in ruins, having been abandoned in 1838 after a long decline. Today it is a popular tourist site.

Walter and I unloaded our packhorses in front of a modern visitor's center, and then we rode up to ruins on an asphalt service road. We surprised a group of tourists in pastel pantsuits and straw hats, who converged on us and began taking pictures and asking questions. Then the wind picked up and blew a cloud of dust through the ruins, which was followed by a scattering of heavy drops. The crowd, clutching their hats and cameras, went running for their cars.

Walter and I sat on our horses and watched the eroded walls of the ancient pueblo, once the greatest city in America north of Mexico, darken in the rain.

"I guess it's over," I said after a moment.

"Yup," said Walter. "Let's go home."

The travelers close in on Pecos National Monument, 950 tough miles from their start on Mexican border. Photographer Nelson holds Acomita, a dog they adopted when it followed them from Acoma Pueblo.

Opposite: *Kiss of Judas* (detail) is one of 13 works in central nave of Basilica of San Apollinare Nuovo that depict Christ's passion and resurrection. Plain facade of Basilica of San Vitale (above) belies mosaics within.

By Robert Wernick

Fifteen centuries later, Ravenna's mosaics still glow

Selected for its isolation, a refuge in a torn world, the city became the center for miraculous works celebrating divinity

"In the eventful history of a reign of twenty-eight years," says Gibbon in the twenty-ninth chapter of *The Decline and Fall of the Roman Empire*, "it will seldom be necessary to mention the name of the emperor Honorius." He was indeed among the most insignificant of Roman rulers, boastful, lazy, cowardly, content to look on languidly while his country fell in ruins around him. He did, however, make one major decision for which the world owes him a debt of gratitude. In the year A.D. 402, fearful of being overrun by the barbarian hordes that were roaming at will over his domains, he moved his capital to Ravenna on the Adriatic Coast. Protected by the vast marshes of the Po River and approachable only over an artificial causeway, this city was impregnable to direct assault and managed to survive for centuries isolated from the bloody turmoils of the dying ancient world. As capital of the Western empire in its last days, then as capital of the Occidental provinces of the Eastern (Byzantine) empire, it offered a refuge of luxury and splendor, a beachhead of antique civilization in the rising seas of barbarism. It was crowded with sumptuous palaces and churches.

Ravenna's glowing mosaics

Haloed lamb, representing Christ, in wreath supported by angels is focus of presbytery dome in San Vitale.

Honorius and his successors decorated the walls of these palaces and churches with works of incomparable richness, the masterpieces of an age when human creative achievement was reaching one of its summits. The hazards of war and religious fanaticism have all but annihilated them. Only in the Ravenna churches that survived do some of them remain, with all their deep, throbbing brilliance intact.

The saints and symbols on the walls of Ravenna look almost exactly as they did when they were created in the fifth and sixth centuries. This is because they are mosaics, and well-made mosaic is the most durable of all decorative techniques.

Virtuosos of colored glass

The use of small colored objects to create surface patterns is an ancient art form spread over most of the world, used by architects building the temples of Uruk in Mesopotamia in the fourth millennium B.C. and by Pueblo Indians making turquoise plaques in New Mexico today. Its use in making large pictorial compositions appears to have been a unique product of classical civilization, born in Greece, developed by Rome. Beginning in the fourth century B.C., pebbles and shells were replaced by colored glass baked into thin sheets that could be cut up into thousands of little pieces, tesserae, square or oblong or any irregular shape that might be desired, most only fractions of an inch across. The tesserae were set in wet plaster by skilled craftsmen following lines traced by the master of the work. Once the plaster dried they would stay in place indefinitely.

Ravenna artists were heirs to centuries of Greco-Roman masters who had achieved an awesome technical virtuosity. They had something like 300 different shades of colored glass at their disposal, and they knew how to use them to produce any kind of pictorial effect they wanted, from stark geometrical abstractions to delicately modeled landscapes, hunting scenes, battles, the loves of Mars and Venus. Producing mosaics was a major industry under the Roman empire; no substantial building was complete without them. Rich people could choose patterns for their homes the way their modern counterparts choose carpets: identical designs have been found in Roman ruins in the north of England and on the fringes of the Sahara.

The Ravenna artists—chroniclers of the time who failed to record their names, so we do not even know if they were Greeks or Romans—made use of all this tradition, but they changed it utterly. For one thing, they moved the position of their mosaics. Except in damp environments like bathhouses, the Romans had preferred to fresco their walls and had used mosaic almost exclusively for floors. The mosaicists of the fifth

Apse dome mosaics of San Apollinare in Classe, three miles from Ravenna, were accomplished at peak of mosaic technical skill, when church, the largest early Christian basilica, was consecrated in A.D. 549.

century did not want their images to be walked on—they were sacred images. Christianity, once a despised sect, was now the official religion of the empire. The churches rising everywhere on the ruins of the ancient temples of the pagan gods proclaimed the triumph of the new faith.

The decorations of the churches were meant to seize the worshiper and transport him to a new and better world. The architectural effect was consciously dramatic. Nothing on the outside of the building prepares your eyes for what they will see inside. The facades and bell towers are unadorned red brick, quiet, harmonious, ascetic. Once past the doors, you are met by a visual blast of heavenly trumpets. Supported by columns of multicolored marble, jasper and porphyry, the ceilings and walls are ablaze with symbolic figures and narrative scenes of the sacred past.

Form and color are part of a careful program. The mosaics were not intended as mere wall decorations; they were an integral part of the architectural effect, enclosing the congregation in an atmosphere that was at once instructive and exciting. A symphony of shapes and symbols was to conduct the eye toward the triumphant truth of revealed religion. Truth was overhead, in the rounded ceilings of domes and apses, in the form of a golden cross in a starry sky, a Virgin and Child, a mystic lamb, a baptism in the Jordan. On the walls below, drawing the eye upward, were scenes from the Old Testament—the sacrifices of Abel and Melchizedek, the visions of Moses and Elijah—prefiguring the coming of Christ; scenes from the New Testament confirming the prophecies of the Old; processions, rituals, saints, martyrs, birds and beasts and flowers, all in their appointed places, all caught up in the same rhythm of praise to the Creator of all.

For all this the mosaicists of Ravenna needed a new style. They had no need for the wonderful ease and grace with which their Greco-Roman forebears had represented the liveliness of the natural world. They had no use for the acres and acres of frolicking gods and godlets, charging cavalry, nymphs pulling the beards of satyrs, rose gardens—dream landscapes that

Robert Wernick is a regular contributor to these pages. His most recent story, in last month's issue, was on the collapse of the South Sea Bubble.

covered the floors of ten thousand Roman palaces, shrines and country houses.

The new art dealt instead with another world, the world of divinity—what Saint Augustine called the City of God, inhabited by those who had given up the deceits and pleasures of this life for the promise of eternal bliss. Mosaic must have seemed like a heaven-sent medium for representing the City of God. The Ravenna artists knew, as Seurat and the Pointillists were to discover a millennium and a half later, that fragments of pure color, seen at the proper distance, can coalesce into images of density and power.

The inward glow that they seem to emanate comes from their being made of glass, which reflects light where paint tends to absorb it. The reflections could be multiplied, and the effect enriched, by setting the tesserae at slight angles to one another. The unevenness, imperceptible at a distance, helps the rich colors produce an effect that was designed to be unearthly—especially when viewed as they were originally meant to be, in light from windows made of thin strips of translucent marble.

The flowering of the new style can be followed church by church over two centuries in Ravenna. In the oldest of the monuments, built around A.D. 430 and called the Mausoleum of the empress Galla Placidia (though in fact she died in Rome and was buried there), the old naturalistic tradition is still strong. Except for the great gold halo that surrounds his head and the giant cross he bears, the young beardless Christ holding out a tender hand to one of his lambs might easily be mistaken for a young pagan god, an Apollo. The big-antlered deer tripping on light feet through a fretwork of acanthus boughs to a pool of rippling water might simply be thirsty deer; it took the eye of an initiate who had read Psalms 42:1 to realize that they represented catechumens, converts to Christianity undergoing instruction to prepare them for baptism in the waters of life.

Processions of saints and virgin martyrs

In the Basilica of San Apollinare Nuovo, built by the Ostrogothic king Theodoric in the next century, the style remains as vibrantly colorful, but it has become more solemn and monumental. In the series of New Testament scenes that runs along the upper part of the north wall, Christ is still beardless and serene, but on the south wall there is the saddened, bearded visage (p. 54) that would be the standard for religious art ever after. Beneath these scenes are two long processions running the length of the nave, virgin martyrs to the north, saints to the south, bearing offerings to the Lord, who is a babe on one side, an august, bearded judge on the other. There is little effort to give these giant figures the look of ordinary life; they are motionless, hieratic components of a heavy, steady sweep of dazzling white and gold, pulling the eye hypnotically forward toward the contemplation of divinity.

By the time the emperor Justinian was reigning, in the middle of the sixth century, the mosaic style had reached its height of formal fixity and grandeur. Justinian himself appears on one wall of the Basilica of San Vitale, surrounded by his court, and on the facing wall the empress Theodora (opposite) and her ladies-in-waiting gaze back with the same great staring eyes. The two monarchs and their attendant dignitaries, the bald-headed ascetic Bishop Maximilian and what are generally believed to be General Belisarius and his wife, Antonia, and the money dealer Julian (who financed the building) may well be portraits drawn from life, but there is no effort to show them realistically, as they might be standing in a real-life liturgical ceremony. They partake just enough of nature to be recognizable as men and women, but they are men and women touched by what Yeats called the artifice of eternity. Inside these walls they are not the mortal sinners who intrigued and ruled in Byzantium; they are in the City of God, in everlasting adoration.

In San Apollinare, a symmetry of symbols

In the Church of San Apollinare in Classe, a few miles outside Ravenna in what was once the great naval base of Classis, no one would mistake the scenes—also of Justinian's time—for anything to be found in nature. The hand of God at the top of the rounded ceiling of the apse comes down through bands of pink-and-blue clouds to bless a great jeweled cross of gold flaming out of a deep-blue sky lit by golden stars (p. 57). The cross here represents the Transfiguration on Mount Tabor, when Jesus was first revealed to the apostles Peter, James and John as the Son of God. The face of Jesus appears in a medallion at the center of the cross; at the ends of its arms Greek and Latin inscriptions proclaim the Savior of the world, Alpha and Omega, the beginning and the end. The apostles appear in the form of three sheep witnessing the divine event on Earth while the prophets Moses and Elijah, who have foretold it, look down from heaven. Below them is a vast verdant meadow overspread with daisies, lilies, olive trees, cypresses, bare rocks, birds, 12 snow-white sheep. These sheep stand, according to varying interpretations, either for the Twelve Tribes of Israel or the Twelve Apostles. They are symbols of all mankind, here turning their heads obediently to a good shepherd, the martyred bishop Apollinarius, who first brought the true faith from Syria to Ravenna in the first century of the Christian Era.

Even today, when only a few scholars know what all

Portrait of Theodora shows majestic empress; she began career, said Procopius, as an exotic dancer.

Overleaf: Background of burnished gold sets off the graceful and flowing pilgrimage of the Three Wise Men.

SCS BALTHASSAR

SCS MELCHIOR ✠ SCS GASPAR

At the Basilica of San Apollinare Nuovo, in one of 13 tableaus depicting the parables and miracles, a youthful, serene Christ wears a tunic of imperial purple and has a halo of jewels in the shape of a cross. He asks Peter and Andrew to fish among men.

these symbols are supposed to represent—that, for example, the peacock stands for eternal life because it was believed (Saint Augustine states it as a fact he had personally observed) that its flesh does not putrefy—they stand out on the walls with a splendid certainty and self-assuredness that can be overwhelming. Some rigid souls in times past thought that the effect might be altogether too overwhelming. Pope Gregory the Great in the seventh century is said to have insisted on dulling the brilliance of these mosaics because it distracted the faithful from inward contemplation. But for most of the faithful, their beauties created pride and exultation. When, in the year 988, in one of those rare individual decisions that affect the course of history for centuries afterward, Prince Vladimir of Kiev led all his wild Russian subjects into the Dnieper to be baptized in the Greek Orthodox community (rejecting the rival appeals of the Muslims, the Jews and the Roman Catholics), the decisive influence on his choice, according to the oldest of Russian chronicles, was the report of the emissaries he had sent to Constantinople. There they had seen the glowing glory of mosaics like those in Ravenna in Justinian's Basilica of the Holy Wisdom, Hagia Sophia. This, they said, must surely be the home of the Eternal.

These emissaries of Vladimir paid no more attention than Augustine or Justinian would have done to what strikes the modern mind so forcibly—the radical, violent contrast between the splendid certainty of the art and the wretched confusion and chaos of the world in which the art was being created. Augustine and Justinian would have had nothing but contempt for the modern notion that art should be a faithful reflection of the life of its times—that disordered times require disordered art. They were all too well aware of what their times were like; there has probably never been in Western history a time of greater disarray, destabilization and destruction than the fifth and sixth centuries A.D. The pillars of the world were shaking. The waves of barbarism were washing away the monuments of a thousand years of civilization like so many sandcastles. In the year 410, Rome itself, the Eternal City, was stormed and plundered by Alaric the Visigoth. "The light of the world was put out," said Saint Jerome. This was a Day of the Lord such as had been foretold by the Hebrew prophets, when the grapes of wrath would be trampled out.

A bloodsoaked brutality had infected the world. The Romans might turn up their civilized noses at crude barbarians like King Alboin of the Lombards who, according to eighth-century historian Paul the Deacon, liked to drink toasts out of the skull of the father-in-law he had murdered. But civilized life itself was run through with the same streak of grotesque sadism. The emperor Valentinian I, regarded as a model of both noble Roman and pious Christian, kept

two pet bears named Innocence and Golden Grain, and when the cares of office kept him awake at night, says Gibbon, he would have prisoners brought up from the dungeons so that he could watch them being mauled and dismembered till his eyes drooped in sleep.

The rulers who commissioned the great churches of Ravenna led violent and passionate lives, stained with crimes, and were always in dread of foreign foes and domestic treason, never sure that their crowns were steady on their heads. The empress Galla Placidia, sister of Honorius, was part of the spoils of war when Rome fell to Alaric. Shortly afterward she married Alaric's brother Ataulfus. After a wedding ceremony in Nîmes during which a hundred bowls of stolen gold pieces and jewels were strewn at her feet and a former emperor of Rome sang the nuptial hymns, she reigned for four years as queen of the Visigoths, till Ataulfus was murdered in Barcelona and she was forced to walk ten miles tethered to the horse of his killer. Ransomed for 450,000 bushels of wheat, she had to fight off the incestuous advances of her brother Honorius, a contemporary historian tells us. She fled to the court of her nephew in Constantinople and returned with a war fleet to Ravenna, where she ruled for 25 more years, during which she lost half of Rome's remaining provinces to the Vandals. Her daughter Honoria, brought up in the stifling piety of the Byzantine court, where they did nothing but pray and fast and listen to sermons, was a hot-blooded girl who did not see why she did not have as much right to a virile barbarian as her mother. She found herself a superbarbarian in Attila the Hun, and she sent a love letter and a ring to him in his camp on the banks of the Danube. When her mother found out, she clapped her into a convent for the rest of her life, but Honoria had already provided Attila a plausible excuse for invading and pillaging the empire anytime he wanted to redeem his promised bride.

The empress Theodora, who stands in state on the wall of San Vitale wearing a jeweled crown that was to be the model for the crown of Mary, Queen of Heaven, in the windows of Chartres 700 years later, was the daughter of a very common subject, the keeper of the imperial bears. The historian Procopius, who was a high official in the Byzantine court, wrote that in her youth she appeared naked on the stage in the Byzantine equivalent of burlesque shows and sold her charms at high prices through all the cities of the East, before she settled down to a life of ostentatious piety in Constantinople and caught the eye of the dour emperor Justinian.

Such matters were of no concern to the artists of Ravenna. They were indifferent to them, as Augustine was indifferent to all the details of history not recorded in Holy Scripture: "They may be true, they may be false, but they make no contribution to our living righteous and happy lives." What counted was not Justinian the conqueror or Justinian the lawgiver, but Justinian who summoned and presided over the Second General Council of Constantinople, where 273 bishops fixed for all time the definition of the double

Detail of glowering, but gorgeous, lion of San Marco is a tiny element in San Vitale's huge presbytery. The proud lion later became the symbol of Venice. Mosaics here combine veneration with natural history and a lush botanical garden.

nature of the single Second Person of the Trinity.

The mighty imperial apparatus that Justinian built lasted almost 900 years, but then it crumbled away to dust. His colossal bronze statue that stood for so many centuries in front of the imperial palace was melted down to make Turkish cannon.

Art lasts longer than empire, but it too is subject to the vagaries of time and chance. "Now I have vanquished thee, o Solomon," cried Justinian when he first walked inside Hagia Sophia, admiring its resplendent walls. But not long after his death a wave of religious fanaticism outlawed the representation of the human figure; the mosaics were chiseled off the walls of the churches and for 150 years Byzantine religious art lay in the cold grip of abstraction. Then there was a reaction, and the images of Christ, Abel, Melchizedek, the peacocks, all came back in vibrant color. Byzantine mosaicists never quite recovered the firm and delicate balance between natural form and supernatural symbol that marked the art of the sixth century, but they went on producing masterpieces both at home and in neighboring lands—in Damascus, Kiev, Venice, Sicily—all the way down to 1453. Then, with the final extinction of the Roman empire by the Turks, Hagia Sophia became a mosque and its walls were whitewashed. The art of the mosaic, deprived of the well-endowed imperial workshops that passed on the rigorous principles of the craft, languished and died.

Ravenna, too, languished. It fell to the Lombards in the ninth century and to the Franks in the tenth. Under the terms of what was called the Donation of Constantine, forged for the occasion by resourceful monks, the Franks handed it over to the popes. Pope Leo V was so grateful that he authorized Charlemagne to take off whatever he wanted for the decoration of his new capital at Aachen, and endless teams of oxcarts carried off over the Alps in a few months more art treasures than had been lost to four centuries of barbarian raids and lootings.

As an independent city-state, Ravenna took part in the perpetual wars and feuds of medieval Italy. Dante, condemned to death for being on the losing side of a civil war in Florence, came here to finish the *Divine Comedy* and to die. In the 15th century Ravenna be-

came part of the Republic of Venice; since 1860 it has been the capital of a sleepy, now reasonably prosperous, Italian province. The land has risen, and the marshes that once protected the city are now grainfields, cut across by canals bringing seagoing ships to the petrochemical plants whose fumes are slowly eating away the ancient buildings. There are plans to make it the site of an Italian-style Disneyland.

Out in the fields that cover the ancient port of Classis, where all 250 warships of the Roman Eastern Mediterranean fleet once berthed, the spare harmonious bell tower of San Apollinare in Classe rises above a featureless plain. It was marked for destruction by Allied bombs in World War II—the Germans were using it as an observation post—but a gallant Polish warrior convinced his superiors that it would be a sin to destroy so priceless a monument of civilization. A plaque on the west wall of the church expresses the gratitude of Ravenna to Colonel Popski, who allowed Saint Apollinarius—as uncertain as his future was—to continue summoning the tribes of Israel to the green pastures of the City of God.

In the fifth-century Galla Placidia Mausoleum, a pair of doves perch on a basin to drink from the waters of salvation. As conceived in Christian symbolism, the doves represent the candor and sweetness of the spirit of Christ, and bring God's heavenly peace to the world.

Galla Placidia Mausoleum is a treasure house of brilliant embellishment. At right is a small detail of fretwork design from an alcove said to have once contained the sarcophagus of Galla Placidia herself. This stark geometric motif was common Roman design.

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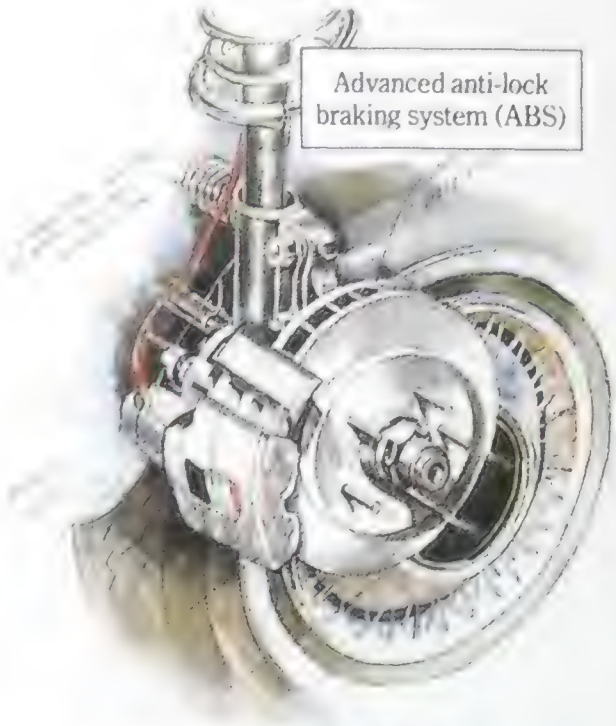

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By Jeanne McDermott

If it's to be heard but not listened to, it must be Muzak

Though some would disagree, there are several beneficial effects, shown by scientific studies, from the elevator music we all know and loathe

While Muzak arrangements may seem strange, they can surreptitiously envelop us with a sense of well-being.

Everyone, except for a few aliens from distant galaxies, has heard Muzak. It plays, of course, on elevators. Many people associate it with the pleasures of being held captive in the dentist's chair or waiting, ear squashed to the telephone, on hold. Others consider it a form of unregulated air pollution, stupefyingly bland and toxically pervasive, as calming a sound as the grinding drone of garbage compactors. Only the pop artist Andy Warhol professed to love Muzak. But then, Warhol also said he would really rather be a robot.

Fortunately, there is more to Muzak than meets the ear. Beyond the dismissive disparagements is the Muzak Limited Partnership, an utterly American, utterly paradoxical story of success. According to an unofficial poll, more than 75 percent of the U.S. population recognizes the company's trademark, an achievement probably surpassed only by Coke, Kleenex and Xerox. Yet, about half of those people turn up their noses. What other company has prospered, indeed has become a household word, by selling something that no one really likes? "The key to Muzak's Environmental Music [the company's term for its best-known product] is that it has created an image that it fully deserves," explains James Keenan, an organizational psychologist and head of Muzak's Board of Scientific Advisors. "Why should you want to listen to our music? You should be doing your job. Of course, it's not high-class music, but then that begs the question of what is. Brahms? That's lullabies!"

Muzak was the first company in the world to make music that people are supposed to hear but not listen to. It also makes the only music in the world that promises to help with our national debt. The Orwellian feat of motivating the subconscious with instrumental renditions of pop hits sounds wildly improbable, until one begins to appreciate the method to this madness. In the company's 55-year history, Muzak has played

Many consider Muzak to be a stupefyingly bland, toxically pervasive form of unregulated air pollution, about as calming as the drone of a garbage compactor.

almost everywhere, from Eisenhower's White House to the Apollo lunar spacecraft to the American Embassy during the evacuation of Vietnam. This experience has spawned a looking-glass logic—one might say an art and a science—to making the music known as Muzak.

Although Seattle does not advertise itself as the Muzak capital of the world, it is. Given the scope of the invisible Muzak empire, the corporate headquarters seems quite modest. On the second floor of a new office building in the artsy Fremont district, the company's famous, or infamous, sounds waft out of ubiquitous brass ceiling speakers. In Christopher Case's office, the volume is cranked up a notch. Case designs Muzak's background arrangements pretty much all by himself. (He does ask his listeners to keep those calls and letters coming.) A nice, pleasant, methodical man of 34 whose black beard is going gray, and whose voice reveals nothing of his Virginia upbringing, Case has an ideal sensibility for making music that is neither too monotonous nor too rousing. A former disk jockey for a variety of stations from progressive and jazz to easy listening, he is now a disk jockey for supermarkets, malls and offices, responsible for the aural diet of more than 100 million listeners in 14 countries. "Every now and then, I miss the radio," he says. "But I like this better. I have more reach. I know it sounds altruistic, but I want to have a positive effect on the world."

Case took the job two and a half years ago, in 1987, after Marshall Field V, the Chicago media magnate and department store heir, bought what was then the Muzak Corporation from Westinghouse and moved it from New York to Seattle. "Westinghouse never really understood us," says Kirk Anderson, former general manager of Boston's Muzak office. "They put us with their radio group but we should have been with office furniture." The new owners understand that even music destined to become wallpaper needs to be updated occasionally. Before Case arrived, someone suggested that perhaps the increasingly high cancellation rate of Muzak subscribers in the early '80s might have something to do with the fact that Czechoslovakia's Brno Radio Orchestra supplied 75 percent of the tunes in the Muzak library. "They came up with a totally alien sound," says Case, but for a price that was right. All of the Muzak on the Main Channel (also called the Environmental or background channel), to which 80-85 percent of Muzak's customers subscribe, is recorded specially for the company by independent musicians.

Illustrations by Robert Osborn

The Environmental Music programs of Muzak's Main Channel are purposefully designed so that they don't interfere with a person's on-the-job concentration.

Muzak had gone overseas in the early '70s, in a quest for orchestras that were less expensive to record than their unionized New York City counterparts. Ironically, the Czechs never had the opportunity to savor their success because Czechoslovakia is one of the countries Muzak does not reach.

The more Muzak changes its tune, the more it stays the same. Case is dropping the Mantovani and the 101 Strings sounds, but no one is tampering with a time-tested formula. In the 1950s and '60s, it was "Gigi" and "The Hawaiian Wedding Song"; in the '70s, "Born Free" and "Raindrops Keep Falling on My Head"; and today it is "Billie Jean" and the theme from *M*A*S*H*. There is a never-ending quest for the familiar, simply because people are more comfortable with it and accept it more readily. As the program manager of the Main Channel, Case spends his free time combing the radio waves, listening to pop, rock, country, urban contemporary, and rhythm and blues. "In the morning, after turning on the lights, the first thing I do is punch on the radio," he says. "Today's Top 40 is a funky, technopop sound, more rap, less ballad oriented. It's hard, stimulating, tense-up music. If I had a choice, I probably wouldn't listen purely for pleasure. As you get older, you have all the stimulation you need." Although he admits, with a shudder, to having liked Alice Cooper, Black Sabbath and Ozzie Osborne as a teenager, his personal tastes now run to "King Crimson, the first two albums. Some of the New Age stuff that is not real dreary. Some of the Madonna songs, Emmylou Harris, Talking Heads."

In the past, chart-topping albums stayed popular for five to six months. But these days, the pop music trends change faster. As a result, Case never has the chance to play a record just for the heck of it. He is jotting notes when he hears a Muzak-able melody, trying to fulfill the mandate of modernizing what has been, until recently, the Muzak monopoly. "If you don't listen for three weeks, you're behind," he says. The radio is on in the bathroom, in the car, over breakfast and dinner, at night and on the weekends. (At work, he listens to Muzak, one of the few people in the world whose job it is to do so.) Silence intrudes between the front door of his house and the car.

At 5:30 this morning, while shaving, Case heard a song by Carole King called "City Streets" and scribbled a note that said "No squealy sax, no heavy guitar." Now, he fans *Billboard* magazine, checking the song's position on the charts. The charts are his reassurance, his hedge against doubt. If a song makes the charts, something about the tune appeals to the masses, even to those who may never hear the original. The song

Jeanne McDermott, a Boston-based writer, thanks her brother Charlie, a Muzak connoisseur, for showing her there's more to Muzak than meets the ear.

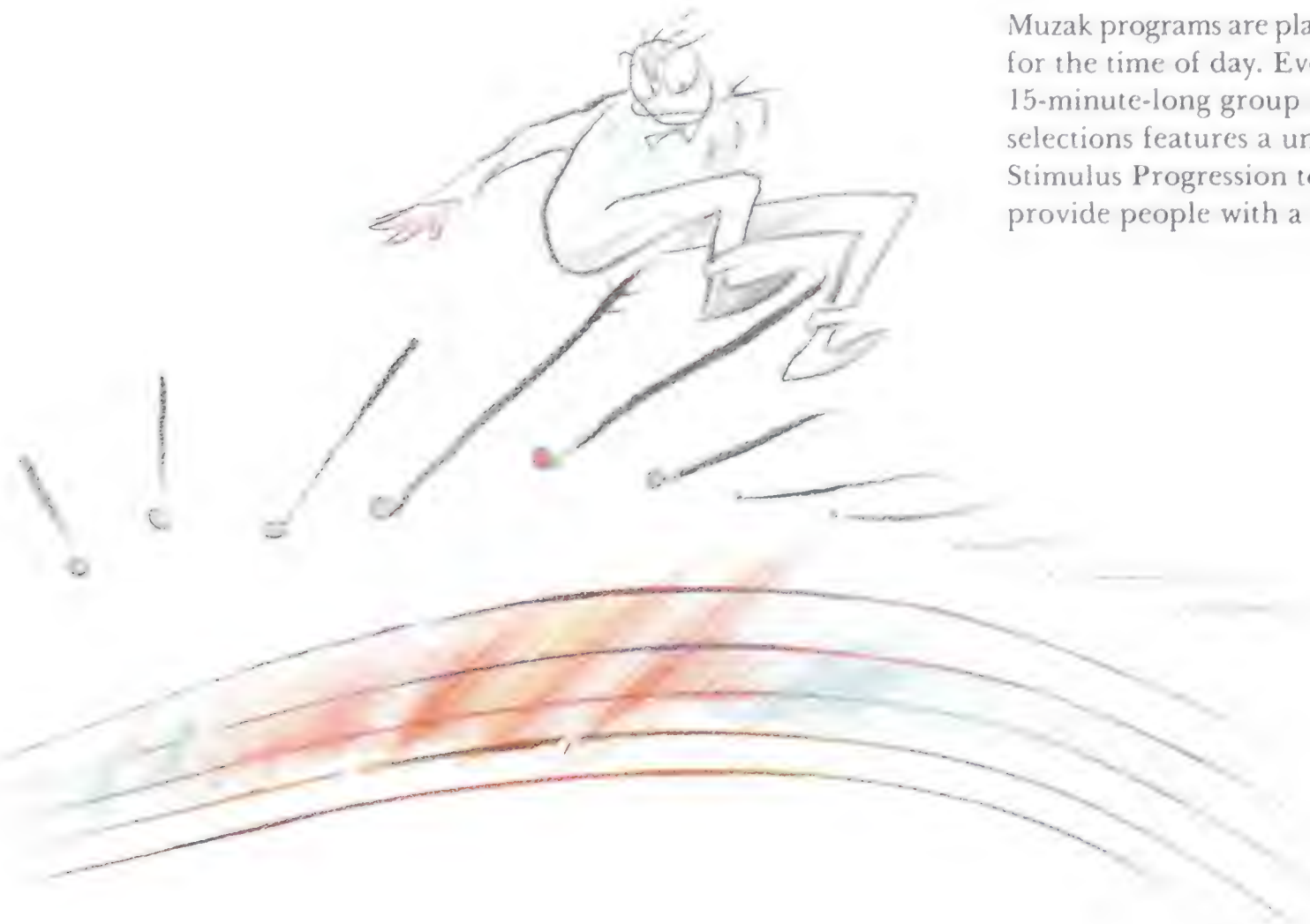
is No. 31 on the adult contemporary chart, up from No. 45 the previous week. Case thinks it will go to the Top 20 next week, and to No. 4 after that. He adds it to the list of the hundred or so song titles that are recorded each month, along with "Head to Toe" by Lisa Lisa and Cult Jam, and "Eighteen Wheels and a Dozen Roses" by Kathy Mattea.

The transformation of a song into Muzak signals perhaps the ultimate popular acceptance. Less prestigious than a Grammy Award, it is an honor equivalent to being condensed by *Reader's Digest*. Paul Simon, it is said, knows that he has a hit when he hears it on the elevator. But Bruce Springsteen, Boz Scaggs and other prominent composers refuse to grant Muzak the right to license their music, and willingly forgo the income they would get.

In two years, Case has replaced half of the 4,000 tunes in the Muzak library, eschewing Communist string orchestras in favor of eight electronically enhanced quartets from Washington, California, New York, Illinois and Hawaii. "I like to say that I'm putting the music back into Muzak," says Case, who defines Muzak as "music artfully performed in a manner to uplift, not to intrude." (The same definition applied to Erik Satie's "furniture music" in the 1920s, and to Brian Eno's "ambient music" in the '70s.) But Case is not using just any old instrument. In fact, he's not using quite a few. Heavy bass, screeching guitars, relentless drums and wailing saxophones are verboten—too stressful. "There is a standing moratorium, forever, on organs, harmonicas, tubas, any instrument that would sound dated or hokey," says Case, who believes that organs belong at baseball games and skating rinks. It may also reflect the fact that Jane Jarvis, a former Muzak programming vice president and organist at Shea Stadium, loved them. There is a temporary moratorium on flügelhorns. "If the flügels are not done just right, they sound dated and whiny with these little speakers," Case says, pointing to the one in the ceiling.

It is hard, if not impossible, to find musicians who are trained at both the composing and decomposing that a Muzak tune requires. Donald Marrow, a Bellevue, Washington, drummer and pianist who once recorded with a rock group called Kidd Afrika and whose dance band plays an occasional gig at a local bar, started working for Muzak two years ago. Working with music and getting paid for it was a better way to pay the bills than, say, selling shoes. When Case remembers the first tape that Marrow and his band made, he shakes his head in fright. "Our phone would have rung off the hook," he says. "There would have been hysteria." Marrow agrees. "Our tendency is to push the music," he says. But he has learned one secret to making Muzak, curling up in a ball to demonstrate. "You have to keep yourself under control."

"I like the blend between the tenor sax and the horn



Muzak programs are planned for the time of day. Every 15-minute-long group of selections features a unique Stimulus Progression to provide people with a lift.

At work, play and in between, the program manager spends all his waking hours listening to the strains of Muzak or music on the radio.

section," Case says when he visits a Seattle recording studio to hear the band's rough mix of "I Heard It Through the Grapevine." The song was a '60s hit, sung both by Gladys Knight and the Pips and by Marvin Gaye, and an '80s hit as the soundtrack to a popular TV commercial for California raisins. "The string bit sticks out," says Case. "Let's see if we can bring up the percussion a bit." In the studio, the musicians swing their heads back and forth like metronomes between takes. "As an artist, it does go against my grain," says Curtis Brengle, a jazz pianist with some classical training who is also the group's arranger. "But then we're not getting paid to be rock or jazz musicians." They are getting paid to sound like the Boston Pops on an austerity budget.

The members of the band guffawed when they first started playing Muzak. Isn't Muzak what makes you want to get off the elevator? But now they look on the bright side, optimism being a trait that Case feels is shared by all those he hires. "We have the opportunity to exercise our own creative vision, to a limited extent," says Glenn Lorbiecki, the band's guitarist and sound engineer. "We are playing the songs we grew up with. The first time I heard one of ours, I was in the store, buying Kleenex. I was thrilled. More people hear our versions than those of the original artists."

If the art of making Muzak lies in not interfering with anyone's day, then the science lies in the way the tunes are programmed together. As the program schedule that appears on Case's desk every morning explains, "Muzak programs are planned for the time of day. Each quarter-hour group of selections features a unique Stimulus Progression to provide people with a lift." Stimulus Progression is an article of faith for Muzak insiders, a bafflement to outsiders. "If you work here," says Case, "you believe in Stimulus Progression. It is a tradition."

Donald O'Neill, who joined Muzak in 1936 and later became program director, invented the concept. In O'Neill's day, each Muzak arrangement was evaluated on the basis of its tempo, rhythm and instrumentation, and assigned a Muzak mood rating that ranged from "Gloomy—minus three" to "Ecstatic—plus eight." Today, Case codes the tempo of each tune on a scale of 1 to 6, with the relatively slow Beatles song "Oh! Darling" being a 2, for example. Using other codes to characterize the instrumentation and the feel of the arrangement, each composition is assigned a stimulus value. With a little help from Case and his assistant, Chuck Walker, a computer schedules the tunes into a 24-hour program that is broadcast around the world from a satellite transmitter in North Carolina. Five or six compositions play in each quarter-hour, their stimulus values in ascending order. Each quarter-hour ends with silence. The 15-minute segments follow a Muzak stimulus curve that ascends from 10 to 11 A.M. and from 3 to 4 P.M., when workers typically tire, and descends during the hours that follow noon and 6 P.M. to counteract the excitement at lunchtime and at the end of the day.

"Stimulus Progression is the one and only purpose of the background channel," explains Bruce Funkhouser, Muzak's vice president of programming. "It's not going to get people to arrive five minutes earlier or work 20 percent harder, but it can smooth out some of the rough edges." Stimulus Progression is to Muzak what caffeine is to coffee, the active ingredient. "The idea was to reduce the onset of fatigue," explains Umberto

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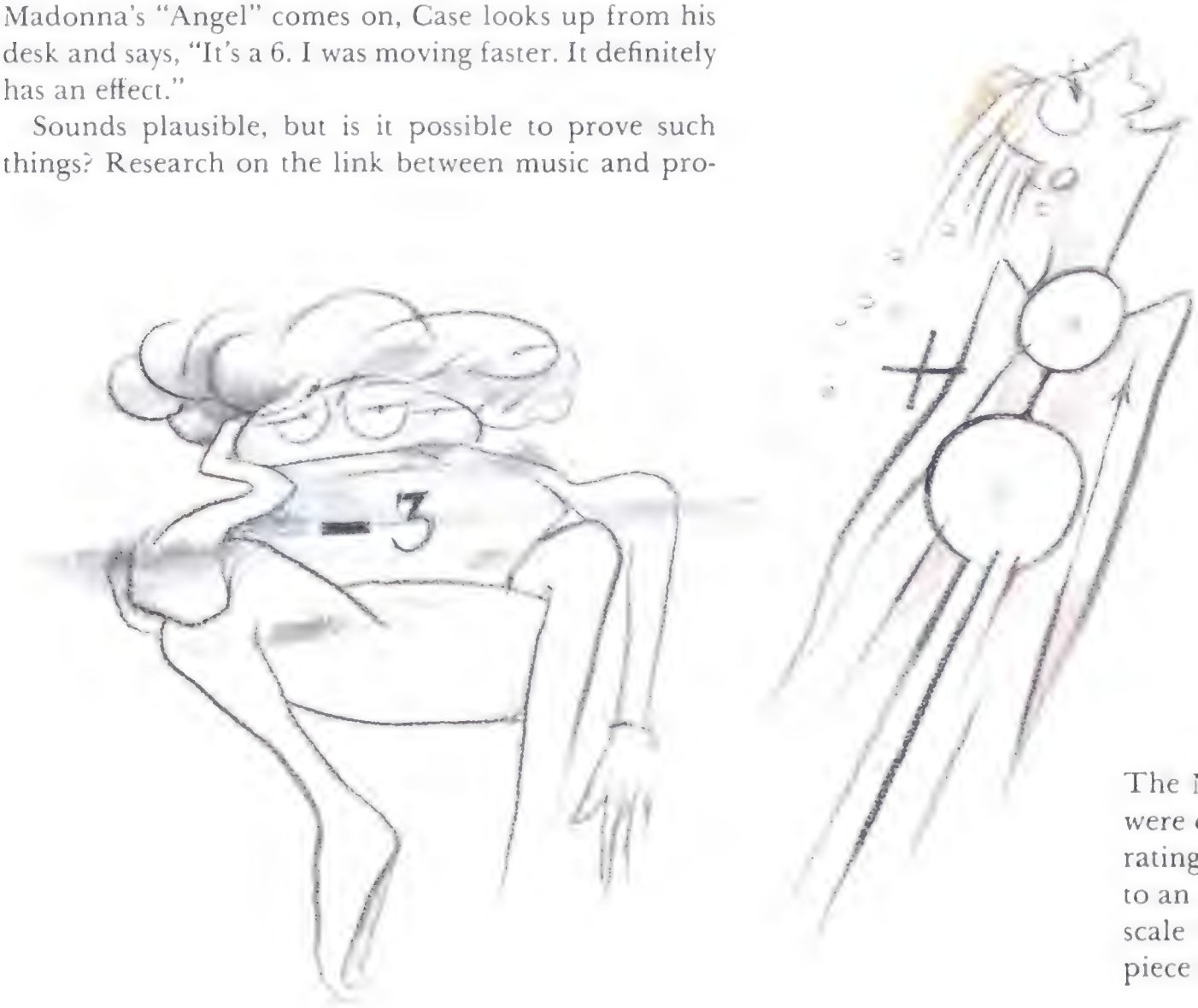
(Bing) Muscio, Muzak's president from 1966 to 1980. Before taking the helm at Muzak, Muscio worked for Fedders, the air-conditioner company. He saw both air-conditioning and Muzak as "ways to improve the physiological conditions of the work area. If workers are in a better physiological and psychological frame of mind, they work better." Case swears that Stimulus Progression works, and he should know. He listens to Muzak all day, monitoring the program and making a change here and there in the tempo codes. When Madonna's "Angel" comes on, Case looks up from his desk and says, "It's a 6. I was moving faster. It definitely has an effect."

Sounds plausible, but is it possible to prove such things? Research on the link between music and productivity goes back to the early days of the Muzak Corporation. Although Maj. Gen. George Squier, Chief Signal Officer of the U.S. Army, founded Muzak's parent company in 1922 with a patent on transmitting music through electrical wires, the Muzak Corporation became an entity and branched off on its own in 1934. In 1937, two British industrial pyschologists, S. Wyatt and J. N. Langdon, published a pioneering study called "Fatigue and Boredom in Repetitive Work," which reported that people work harder when they listen to the proper music. As factories geared up for the war, the British government asked the BBC to broadcast a few hours of music as a way to combat fatigue on the assembly line. When those who assembled planes, tanks and guns increased their output by 6 percent, the U.S. War Production Board took notice and contacted the Muzak Corporation to pipe music into American factories.

The claims that abounded after the war are the same claims, more or less, that abound today: Muzak improves morale, job efficiency, attendance, job vigilance and at the same time, reduces turnover, stress and visits to the watercooler. Zealots also claimed that Muzak helped cows give more milk, chickens lay more eggs and mango trees produce more mangoes, but Muzak



The Muzak arrangements were once assigned a mood rating, from a gloomy −3 to an ecstatic +8. Today, the scale has changed but each piece gets a stimulus value.

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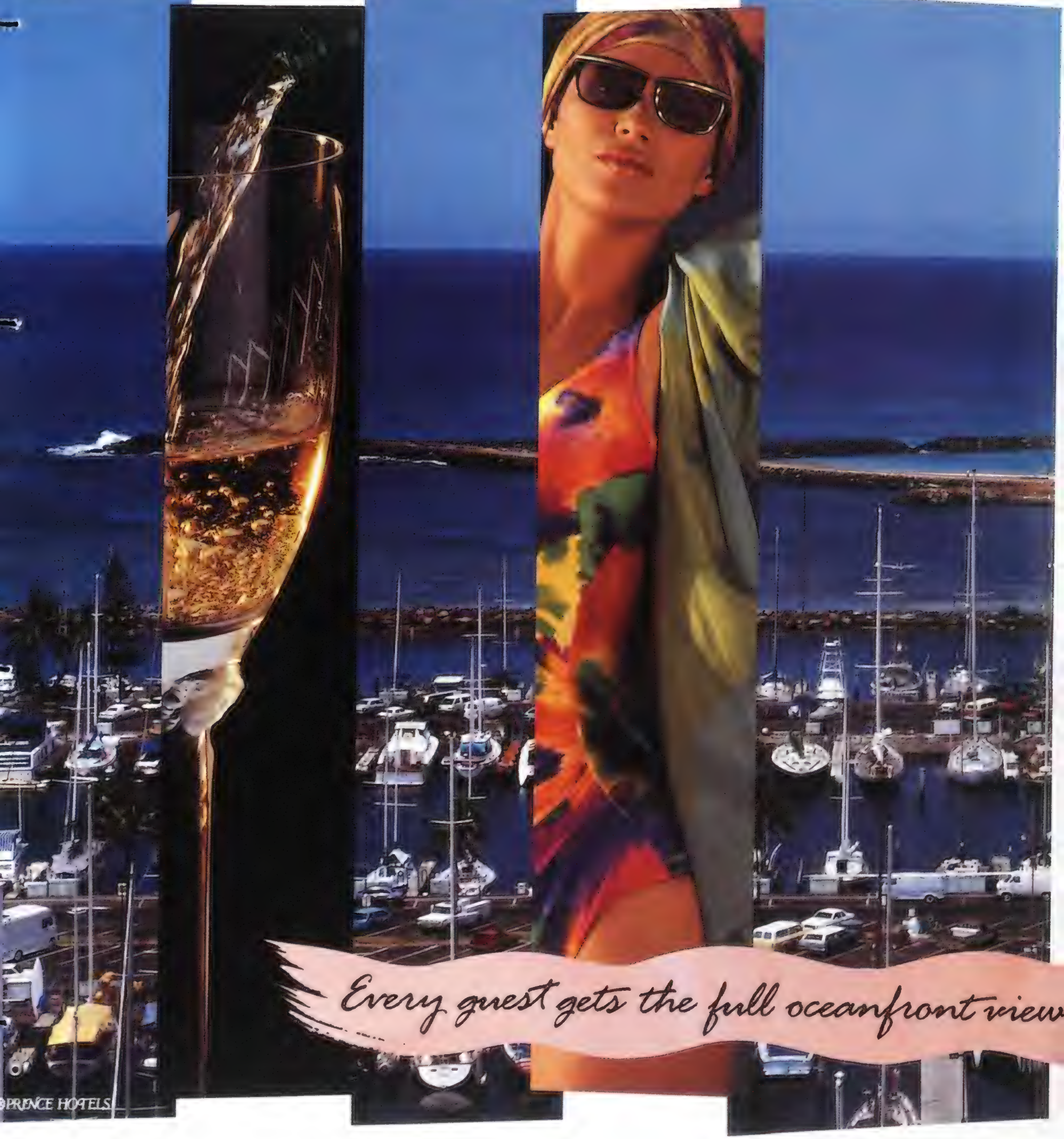
Stimulus Progression is the sole purpose of background Environmental Music. It helps reduce the onset of fatigue and improves the psychological conditions of the workplace.

research director Ellen Goldblatt says, tiredly, "We're not following up the cow theories." "Does Muzak do anything for people?" asks James Keenan, who teaches communication at Fairfield University in Connecticut and heads the Board of Scientific Advisors, a group set up to "aid and assist the company's interest in the science of music." The trouble, he explains, is that music is a very hard thing to define, let alone quantify in a laboratory experiment. "I work on the premise that composer John Cage does—that music is sound heard by millions of listeners."

Still, a few morsels of information emerge. "The mechanical energy that is sound influences and is influenced by our physiology. When we say something is fast or slow, it really relates to the speed of our physiology. When we say something is fast or slow, it really relates to the speed of our heartbeat," says Keenan. The average heart pounds away at 80 beats a minute. "Amazing Grace," which everyone would agree is a slow song, clocks in at 60 beats a minute. Simon and Garfunkel's "Sounds of Silence" runs closer to 100 beats a minute. The physiological influences of music have been documented by a number of studies of hospital patients. For example, Helen Bonny, a founder of the field of music therapy, found that calming music lowered the heart rate and blood pressure of patients in the coronary care unit at Jefferson General Hospital in Port Townsend, Washington.

When pressed again to answer if Muzak works, Keenan says, "Yes, I think it does. In psychomotor environments, there is a clear effect. It has more effect there than in environments where the work is more variable, less programmed." If one believes that Muzak's own research is more than self-serving testimonials, and academic researchers in the field of music therapy clearly do, then Muzak does seem to boost productivity. Keenan's study of 20 adults hired to do clerical tasks found that those who listened to music while performing two procedures—checking names and numbers, and placing dots in circles—worked faster and more accurately. When they listened to Muzak, they worked even faster and even more accurately. At Precision Small Parts, a manufacturing firm in Charlottesville, Virginia, six women who worked with hand tools and dental drills under high-powered microscopes, deburring very small parts used in gyroscopes, completed more parts, upping their productivity by 17 percent in the six weeks after the installation of Muzak. And, at the distribution center for a cosmetics company, which prefers to remain anonymous, absenteeism dropped and clerks made fewer errors in filling orders in the two-month period that was recorded after the installation of Muzak.

But Keenan is the first to admit that Muzak's success in affecting performance of boring, repetitive, psychomotor tasks may have nothing to do with the music itself. He cites a study published in 1930. "In the fading days of Taylorism [scientific management], some Harvard professors did a study of women who were winding coils for telephones at the Western Electric



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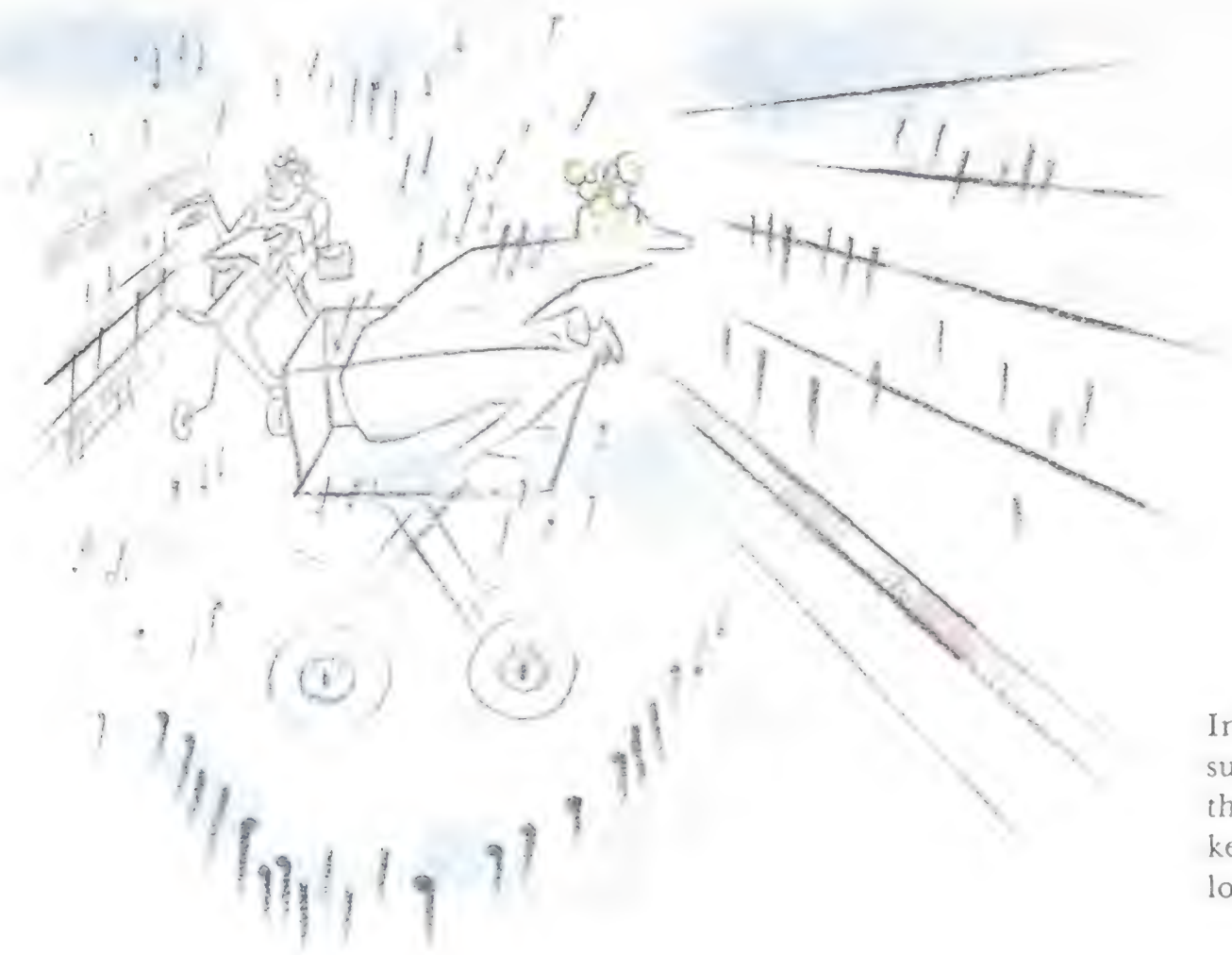

In one study of Muzak in supermarkets, it was found that low-key arrangements kept customers in the store longer, helped increase sales.

Hawthorne Plant, outside Chicago," he says. "It was a seminal work. They wanted to find out if a change in lighting or painting would increase productivity. They selected two groups, a control and an experimental group, and observed them both. Both groups improved. The conclusion was that the attention produced the effects. We sell that concept."

Although conceived as a tool for productivity, it should come as no surprise that Muzak also appears to influence a business' profitability. "When I was in college in Texas in the '70s, I sold Muzak," explains Jeff Warr, professor of mass communication and journalism. "I told people it worked, but it was always in the back of my mind, does it really?" In 1983, at Pepperdine University in Malibu, California, Warr had a graduate student named Gerald Patrick who wanted to find out if Muzak made supermarket shoppers spend more money. Warr and Patrick picked two Gelson's supermarkets in Los Angeles, one in a well-to-do part of town, one in a poorer section. They made two ten-hour tapes—a slower one with Muzak tunes averaging 78 beats per minute, and a faster one, more like contemporary radio, with tunes having at least 94 beats per minute. They arranged for each tape to play in each store on every day of the week over a period of a month, and used the store's computerized price-coding system to calculate the average purchase. One experimenter, who dressed and acted as if he were taking inventory, surreptitiously clocked every fifth person who entered the store, timing how long he or she spent walking down one aisle.

"In a nutshell, we found that slow, low-key music tended to produce higher sales, a higher total ticket and people who stayed in the store longer," says Warr. "Fast music was worse than no music. It meant faster walking, fewer purchases. I wouldn't say that Muzak works in every situation, but in our study in supermarkets in Southern California the Muzak definitely had some kind of impact on consumer shopping." To be precise, customers spent an average of 6 seconds longer on an aisle and 5 percent more money when Muzak played, as compared with no music, and 13 seconds longer per aisle and 12 percent more money when Muzak played, as compared with contemporary music.

At the Stop and Shop supermarket in Fairfield, Connecticut, on a Wednesday afternoon at 3 o'clock, it is hard to even hear the background music. "Muzak has achieved such success that *anything* played in establishments is called Muzak, but not everything you call Muzak *is* Muzak," says Keenan. Over by the canned yams, as Keenan positions himself underneath the speaker, listening for Muzak's telltale silence at the end of each quarter-hour, he conjures up a pre-Muzak world. "If there was no sound, what would you hear? The clanking of carts and cash registers." Then he explains the way a typical sales pitch goes. "The data suggest that the music that people *like* keeps them in here. Now, one hypothesis is that people are spending

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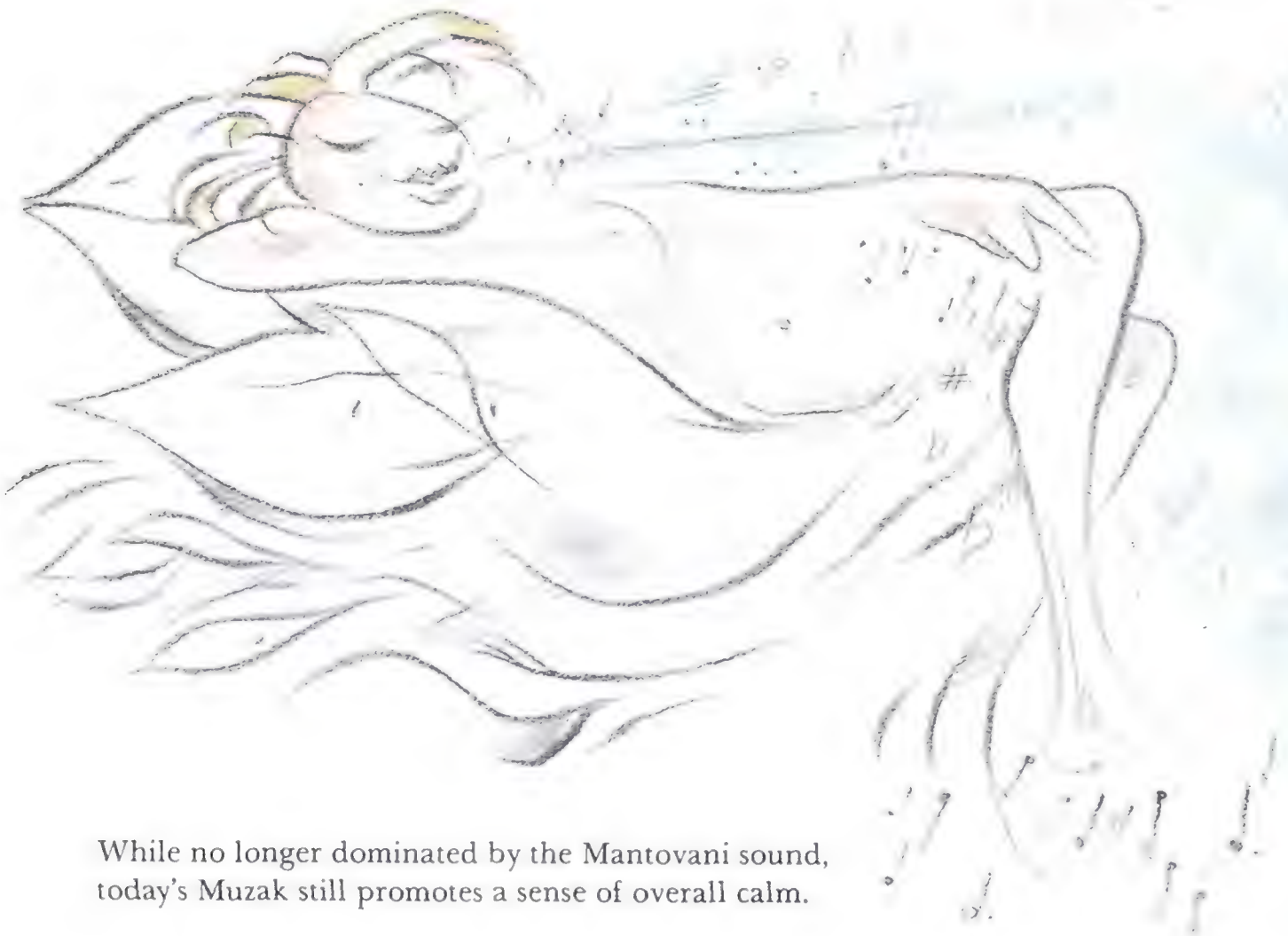
more time reading labels." He points to a woman doing just that. "The increased time might not translate into increased profit, but these stores operate on so little profit that any increase means a lot. There is something to be said for keeping the checkout clerks happy. We know that people see Muzak as a sign that the store cares. Older people like it. Women like it better than men, and women do most of the shopping. For a fraction of a penny per customer per day, why not? What do you have to lose?"

The mathematics of Muzak are compelling. At $50 a month, which is the average cost of subscribing to the device that decodes Muzak's special radio signals, it does not cost much. As Al Shell, who owns the Muzak franchises in Baltimore, Kansas City and St. Louis, says, "The coffee, the janitor, the plant service cost more than Muzak. Muzak gets to every employee, every minute of every day. The money is insignificant. It's worth the chance to see." But why not just play the radio? Or, better yet, bring a tray of tape cassettes from home? A lot of businesses do. But almost no one realizes that it is against the federal copyright law to play any music—including the radio—in stores, offices, restaurants or any profit-making establishment without paying the musicians' unions. In the end, it doesn't really matter whether or not Muzak works: it's not illegal.

In what may be the ultimate paradox, the musicians themselves promote Muzak. Muzak pays 5 percent of its gross to the American Society of Composers, Authors and Publishers (ASCAP) and 3 percent to Broadcast Music Inc. (BMI), the two largest musicians' unions. Since Muzak grosses $50 million a year, that means $4 million goes to the two unions, no small change. ASCAP and BMI take care of enforcement, soliciting hot tips with easy-to-use postcards sent to Muzak sales offices around the country. Lawbreaking businesses—with the exception of mom-and-pop outfits—get a visit from the musicians' unions and, before long, Muzak or another music supplier usually signs up a new customer.

Despite its omnipresence, the Muzak Partnership hopes to expand its empire. Today, it permeates the factory, office, supermarket and shopping mall. Tomorrow, it may reach the executive suite. "Upper management is a hard sell," admits Bruce Funkhouser. "They have doors. But I think you'll see more of these." On the wall in his office is an on-off switch, a control knob, a master zapper. Imagine, for a second, how it would feel to put Muzak on hold. It might just give the company a whole new image.



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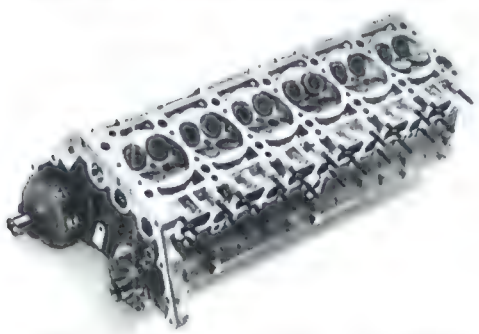

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By Ellen Ruppel Shell

Seeds in the bank could stave off disaster on the farm

Concern over vanishing—and vital—genetic plant material is sparking diverse private and government groups to seek solutions

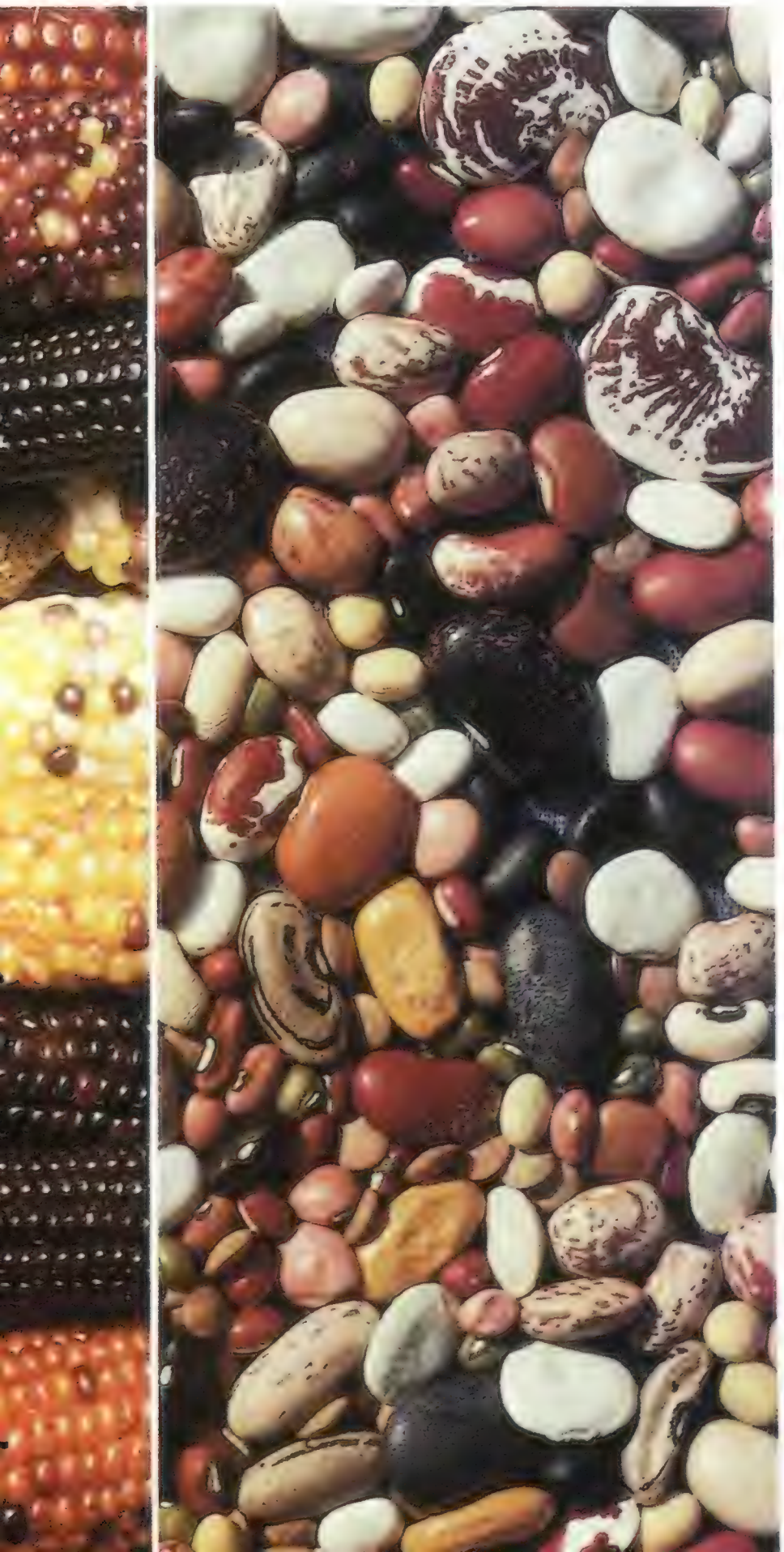
It's barely 7 o'clock on a brisk spring morning, but the campus of Colorado State University in Fort Collins is already bustling with activity. On the track, joggers trot, runners sprint, while couples stroll and skateboarders glide nearby. Casting a feeble shadow over these proceedings is an undistinguished structure of tan-colored concrete and sandstone. This is the U.S. Department of Agriculture's National Seed Storage Laboratory (NSSL)—Fort Knox to our agricultural heritage. There are no bars on the windows, no security guards at the door, yet the billions of seeds stored here are beyond price—they are said to be our last line of defense against agricultural bankruptcy.

This stodgy, three-story building houses the largest and most diverse collection of seeds in the Western world. More than 250,000 seed samples are kept here, and that number increases by an average of several thousand each year. The NSSL is the central storage facility for the USDA's National Plant Germplasm System. Separate working collections of plants in the system are at four regional Plant Introduction Stations or related facilities, where they are maintained, regenerated, evaluated and distributed on request. Duplicate seeds from each collection are sent to NSSL, and evaluation material is transmitted to the national computer data base of the National Agricultural Library at Beltsville, Maryland.

Fort Collins specializes in crop plants: corn, soybeans, wheat and the like. Seeds come from anywhere and anyone—from seed companies, government agencies, scientists, farmers and gardeners. Entrance requirements are flexible: seeds of esthetic or economic value are gratefully accepted. There is soybean from China, wheat from Turkey, rice from Japan and corn from Brazil. Dorris Clark, a plant scientist who spent the better part of his career at the seed bank before retiring in 1988, points out that these plants are the bedrock of the American diet.

"As rich as it is in natural resources, the United States has very few major native food crops," Clark says. "Corn, for instance, was brought in from Central America, and we certainly don't have any indigenous wheat or rice. What is native are wild blueberries and cranberries, sunflowers, pecans, some varieties of beans and squash—that's about it. All our major food crops have come from other parts of the world. As a people, we have always been very aggressive about importing seeds from outside. The Massachusetts Bay Colonists, for instance, brought seeds with them and had a standing order for more from every ship coming to the New World from Europe."

Naturally, they and other early settlers did not have the foresight, or the resources, to institute a seed bank. In fact, until Fort Collins opened for business in 1958, tens of thousands of seeds from around the globe, collected by USDA plant breeders and other scientists, were stored, if at all, in attics, barn lofts, offices and garages. There was no central facility for preserving seed and no funding for it. "When plant breeders went back to reevaluate stored seeds for desirable genetic



Heirloom vegetables from Seed Savers Exchange are, from far left, edible squash with decorative gourds; potato cultivars; heirloom and Indian popcorns; beans. These varieties and others are available to members.

Photographs by Terrence Moore and David Cavagnaro

Kent and Diane Whealy cultivate more than 1,000 kinds of vegetables at Heritage Farm, Decorah, Iowa.

Among Whealys' old varieties are lettuce called Grandpa Admire's and colorful, hot Aurora peppers.

characteristics, often the seed was dead," Clark says. It is estimated that as much as 90 percent of seed samples brought into this country before 1950 was lost owing to neglect or ignorance. "In many cases we couldn't go back to the country where the seed originated, because of political pressures," he explains. "For example, for years we couldn't get plant materials from China or the Soviet Union."

Seeds are, of course, our major food source, since they or their products sustain us directly, and indirectly through animal feed—but their value doesn't stop there. The seed is prelude to the plant, and contains within it all the information necessary to guide the plant's development and survival. These instructions are embodied in a substance called germ plasm, the genetic material that, encoded in seeds and other plant material, distinguishes one individual from another. The genes in germ plasm allow one plant to survive a drought, when all around it shrivel and die; they hold the key to resistance to disease and insects. So it was concern not for the seeds per se, but for their value as germ plasm that prompted the institution of a worldwide network of seed banks. In 1974 an international community of concerned scientists, along with the United Nations Food and Agriculture Organization (FAO) and various other groups, established the International Board for Plant Genetic Resources to oversee this network. By 1985 there were an estimated 227 national gene banks in a hundred countries and several international research centers involved in germ plasm storage. Even more are needed.

Germ plasm is vulnerable stuff. Left unprotected it tends to erode. Modern development—burning of forests, clearing of marginal land, overgrazing—especially in the Third World, is causing the extinction of hundreds of wild plant species that the world may well need for future agricultural and medicinal

Here, they inspect a tomato plant. Cages shield self-pollinating peppers and eggplants from bees.

Other favorites: array of heirloom watermelons and the unique Red Turkish eggplant, increasingly popular.

purposes. And, while not actively destroying plant varieties, modern agricultural techniques add to the problem. This is because today's marketplace and farming techniques require uniformity in plants, particularly in our food crops—uniformity that allows them to be grown quickly and in massive quantities. To be profitable, all tomatoes in a given field have to mature to about the same size at about the same rate so that they can be picked in one day by one mechanical harvester. Any plant that doesn't measure up, whose fruit ripens a few days late, for instance, might as well be a weed. Modern farmers don't want variety. They demand high productivity and hardiness, and plants that produce fruits and vegetables that will stand up to the rigors of machine picking, long-distance shipping and long-term storage. All of which hybridization—the crossing or other manipulation of the germ plasm of seeds—can insure. This makes absolute economic sense. What farmer in his or her right mind would grow a variety of wheat or corn or barley that required more water or attracted more pests or produced less abundantly than another variety? Unfortunately, left unplanted, these less-popular (and frequently indigenous) varieties die out, and with them their germ plasm. That germ plasm, often the end product of eons of evolution, is unrecoverable—once gone, it cannot be replaced. And while the plant itself may no longer be desirable, the genes it carries may well be.

Hanging on to desirable genes

"For a plant breeder to make progress, he has to go out and find genetic potential and exploit it," explains Eric Roos, a plant physiologist and research leader at Fort Collins. "Maximum genetic diversity is key to this process." Scientists develop new plant varieties by breeding or otherwise transferring desirable genes from one plant into another. For example, a perfectly good, sturdy, fast-growing variety of soybean that lacks resistance to attack by a certain insect might benefit from being crossed with a less-productive type that stands up well against the pest. The plant breeder's job is to get the gene for disease resistance into the more-fruitful variety of soybean, either by complex cross-breeding or, probably in the near future, by using genetic engineering techniques to physically transplant the gene. If that gene is unavailable, the plant breeder is out of luck. The seed bank is our main reserve—germ plasm kept in its coffers is not subject to the whims of agricultural fashion.

How important is genetic diversity? Consider the Irish potato famine of the 1840s. The Irish had come to depend on a few varieties of a species imported into Europe from the Andes by Spanish explorers in the 16th century. These varieties had no resistance to the

Christina Vertucci at NSSL studies water properties of seeds to find how humidity levels affect their aging.

Mexican blight that wiped them out. The potatoes rotted, tens of thousands of people emigrated and nearly two million starved.

American agriculture has never suffered such a devastating setback, but it came uncomfortably close in 1970. That was the year a fungus, *Bipolaris maydis*, the Southern corn leaf blight, swept through Florida, across the Southeast and into the plains, leaving in its wake hundreds of thousands of acres of dead and dying corn. The epidemic wiped out 15 percent of the United States' corn crop that year, and sent chills down the spines of farmers and plant breeders. A report published two years later by the National Academy of Sciences (NAS) concluded that *B. maydis* had "made a liability out of a technology that had been devised to improve the efficiency of the nation's agriculture." Part of what had made growing corn so efficient in this country was that the crop had become nearly uniform. This made corn easy to plant, harvest and process. By the late 1960s the seed companies had bred a common genetic trait into hybrid corn that enhanced the efficiency of seed production. But it also increased the corn's susceptibility to the fungus, which thrived on the cool, wet conditions prevalent in the summer of 1970. "The key lesson . . . ," the NAS report warned, "is that genetic uniformity is the basis of vulnerability to epidemics."

Saved by the older hybrid stock

Which brings us back to seeds. Because the seed companies and plant breeders had supplies of older hybrid stock, they could phase out the blight-susceptible variety and revive the U.S. corn crop. If those seeds or similar ones had been unavailable, the resistance would have been unattainable, leaving our corn crop vulnerable to the next epidemic of Southern corn leaf blight. Crop diversity generally averts such sweeping devastations as the potato blight and the corn blight. In a country such as Peru, there are so many different potato varieties that a disease or pest is less likely to make a dent in the overall supply. Thousands of different rices in Asia uniquely suited to the areas in which they're grown illustrate the inherent value of diversity. But in a highly industrialized agricultural economy like the United States', where many farms cover thousands of acres and are planted in only a few varieties of highly productive crops, there is relatively little variation to be found. Here, the seed bank becomes a vitally important, albeit somewhat artificial, source of genetic diversity.

The Fort Collins seed bank itself offers no visible clue to the weightiness of its purpose. Small and crowded, furnished in government-issue gray metal with barely a potted plant in sight, it has the look and feel of a generic administrative office circa 1955. The

Donald Falk, the director of the Center for Plant Conservation, leans against dawn redwood from China. The Center, at Arnold Arboretum in Boston, oversees network of gardens that cultivate rare U.S. species.

main event, the seeds, are on the second floor, piled into row after row of metal trays crammed into dark rooms refrigerated to below freezing. Outside the storage areas, technicians clean and count the seeds, which are poured into small white bags lined with layers of polyethylene film and aluminum foil. Seeds that naturally contain 12-15 percent water are dried down to about 6-7 percent to extend their life. The bags are then heat-sealed and bundled off to the freezers.

Seed, in the words of one plant scientist, is merely a package of potential, a snippet of genetic material surrounded by enough food to get the plant sprouted. Once the plant has roots to suck in nutrition from the soil and leaves to absorb sun for photosynthesis, it's on its own. Low temperatures inhibit the process of germination—cold throws the seed into a state of dormancy, broken by a warm spring day. "Spring" comes at NSSL when the seed is pulled out for a germination test.

The best way to tell if a seed is still "alive" is to allow it to grow. The bank itself runs 20,000 to 25,000 germination tests a year, an incredibly laborious process. Samples of seed are removed from their bags, put on moist paper, then placed in six-foot-high stainless-steel chambers and kept at optimum temperatures.

The longevity of seeds varies, but those of good quality, properly kept, can last for a hundred years or more. Popular legend has it that 3,000-year-old wheat seeds taken from an Egyptian tomb were germinated in the mid-1800s, and in fact grew into three sturdy plants. Popular legend is wrong. The longest-lived seed on record, according to David Priestley, a plant biochemist and author of a standard monograph on seed aging, is lotus seed from Manchuria, estimated to be about 700 years old.

"We are not certain why a seed ages," says Priestley. "There are, of course, a number of ideas; most involve biochemical changes. No one has been confident enough to pin down the exact reason. Philosophically, it's a very interesting question because seeds themselves seem to balance on the border between life and death. In fact, one can put seeds into a sort of state of suspended animation—actually slow down their molecular

The author covers science and technology from her home in Boston and is working on a book on day care that is to be published by Little, Brown in 1991.

Seeds frozen in liquid nitrogen may achieve indefinite viability; this process could preserve those that presently can't be stored. Here, Phillip Stanwood retrieves some rye seeds for research.

motion by cooling them down to near absolute zero."

The seed bank selectively suspends seeds in time, in an effort to lengthen their life. Research agronomist Phillip Stanwood is investigating a system whereby seeds are frozen in tanks of liquid nitrogen at −160 to −196 degrees C, a process that slows their metabolism to the point where they almost cease to age. This takes place in a large room, protected only by a wooden door hung with a sign that reads, "Danger: Room Nitrogen Content High, Asphyxiation and Suffocation Possible." Stanwood pays the warning no heed as he strides in to demonstrate how life can be frozen in time. Explaining that an unprotected hand would freeze solid in minutes, he dons gloves before plunging a fist into one of the fuming nitrogen tanks and fishing out an aluminum canister. The canister is loaded with long, thin tubes, refugees from the electronics industry, each of which he has packed with up to 3,000 seeds.

"Deterioration of seed is the result of some as yet unknown physical mechanism," Stanwood (above) says. "Instead of trying to understand what that mechanism might be, I decided to look at what could circumvent it. This led me to cryogenics [the physics of very low temperatures]. The trick is getting seeds down to cryogenic temperatures and back without damaging them. Ice crystal formation can rupture the cell membranes and walls, but we have preserved 140 different species this way, more than 30 on a long-term basis. And we're hopeful that we'll be able to store a lot more. You could store samples of all the cereals known to Man in just 30 liquid nitrogen tanks."

Cryogenic storage is important not only because it extends the life of the seed, but because it someday might be used to preserve that which, as of now, cannot be stored. Cocoa, rubber, wild rice, tea, and most maple and palm seeds are too high in moisture to keep in conventional cold storage. Attempts to dry them down to the 6-7 percent moisture required for storage have so far been generally unsuccessful, but Stanwood hopes that a cryogenic approach might work.

Despite the efforts of Stanwood and other scientists, however, the seed bank has been unable to keep pace with the influx of seed into the lab. There is simply not enough space: the seed storage area is standing room only—even the walk space between rows of shelves is filled with carts loaded with boxes of seed. Also, some of the lab's refrigeration and insulation has been criticized as being antiquated.

There is no question that improvements must be made, and there is hope that a long-promised Congressional appropriation will allow the Fort Collins facility to move into updated and larger quarters soon. Meanwhile, there is general agreement among experts that the seed bank, while critical, should only be considered part of a larger program of plant preservation. Even under the best of circumstances, a certain percentage of seed will not survive extended periods in cold storage. And when it does survive, according to Henry L. Shands, National Program Leader for Germplasm at the USDA's Agricultural Research Service, that doesn't really offer a complete picture of a species' potential. It is only, as he puts it, "a snapshot of a plant's genetics in time."

Scientists' concern for seed preservation goes beyond

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the agricultural, for botanical gardens face and address similar problems. "Preserving plants through seed storage is akin to having a human on a life-support system," says Donald Falk, executive director of the Center for Plant Conservation at Harvard University's Arnold Arboretum in Boston. "Technically, the plant is still alive, but it's not a useful, productive life. We'd rather see seeds planted in the wild." Living plants are in a constant state of evolution: environmental forces push them to adapt or die. By contrast, a seed in storage can only lose, not gain, genetic variability.

Optimum variability is promoted only by planting and allowing nature to take its course. There is a large and growing network of professional and amateur botanists and horticulturists who are making sure that rare and endangered seeds get a chance to do just that. Donald Falk's organization is dedicated to the preservation of wild American plant species. To that end, the Center coordinates the collection of rare species throughout the country, and their cultivation in nurseries and greenhouses at 20 botanical gardens and arboretums. Falk points out that between 3,000 and 5,000 of the plant species in this country—roughly 10-20 percent—are imperiled or in danger of extinction, and that as many as 700 of these, if left unprotected, will vanish in the next decade. "There is no dignity in extinction," he says. "It's a permanent, irrevocable state. We'd rather see these plants preserved in seed banks than not at all—the seed bank is an insurance policy." As insurance, the Center has sent a few rare and endangered species to NSSL for cryogenic storage.

At the grass-roots level, another category of collectors is concerned with the preservation of heirloom vegetable seeds, varieties that, as their name suggests, are often family treasures passed down from one generation to the next. They are rarely, if ever, available in commercial catalogs and are therefore quite vulnerable to extinction. In fact, according to Diane and Kent Whealy, founders and directors of the Seed Savers Exchange in Decorah, Iowa, about 5 percent of seed company offerings are dropped every year. The germ plasm in these seeds might have vanished forever if not for the efforts of Seed Savers and a handful of other organizations around the country. Seed Savers Exchange members are encouraged to scout for rare seeds in attics, barns or wherever, propagate them in gardens, then make them available for cultivation. The process can be habit-forming: one member grows 400 different varieties of squash in his garden and is anxious to plant more.

Progress of corn seedling's germination is checked at NSSL, which specializes in storing crop-plant seeds.

Thousands of vegetables in the garden

The Whealys themselves cultivate more than 1,000 varieties of vegetables every summer on their 57-acre farm which, complete with a trout pond and a barn restored by Amish workmen, is tucked into a bucolic valley five miles north of Decorah. They also keep a collection of 6,000 varieties of heirloom seeds in small airtight jars lined up in file drawers in their barn. But their goal is to see these seeds planted, not stored.

"Putting seeds in a bank is like putting animals in a zoo," Kent says. "There's a tremendous difference between a field of corn growing in Central America, with all the selection pressures and crossing among varieties, and putting seed in storage to stagnate."

The Whealys say that pressure on heirloom seeds has increased in the past few years. Hard times have forced many farmers off their land, leaving them no place to plant inherited seed. At the same time, seed companies have become fewer and larger. Of the 230 seed companies in existence just five years ago, Kent says, nearly 60 have either gone out of business or have been bought by other firms. These very large companies, some of them multinational conglomerates, are not in the business of producing vegetable seeds that

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by Bev Lopez

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sell only a few thousand packets. So the companies discontinue collections that were developed on a regional basis—say, for short growing seasons or particularly dry weather—in favor of commercial seeds that grow well in a wider area, like the entire Grain Belt. All too often, Kent explains, the result is a monoculture: vast stretches of genetically similar plants. These extremely successful and widespread varieties could completely supplant regional varieties, dangerously narrowing the pool of genes available for plant breeding.

Pioneer Hi-Bred International, the largest seed company in the United States, specializes in the production of just this sort of seed: corn, sorghum, soybean, wheat, alfalfa and sunflower seed designed for the broadest possible use. The company, founded in 1926, was one of the first to market hybrid corn seed. Hybrids are created by the painstaking crossing of one or more varieties to produce plants that, on average, are hardier and more productive than either parent. Hybrid seed is so high-yielding it helped revolutionize food production in the Western Hemisphere. But, because farmers plant so much more of it than of locally developed varieties, hybrid seed has contributed to a dramatic decrease in variety and was a major player in the 1970 corn blight.

"We have bred our seed to grow plants that are more resistant to disease, insects and weather than the native varieties, and for that reason they do drive out local varieties," says Donald Duvick, senior vice president in charge of research at Pioneer. "But that increases pressure on companies like ours to develop new ones. There are hundreds of thousands of varieties in plant breeders' research farms that represent a very wide range of germ plasm. In the last 100 years we have learned to make new combinations out of the plant diversity developed over the previous 10,000 years."

The fact that seed companies can gather seeds from all over the world, modify them by breeding or biotechnology and patent the results has caused worldwide concern over who, if anyone, should control germ plasm. Some conservationists argue that, since germ plasm is a gift of nature, no person, organization or nation should have the right to profit from its use. Developing countries that consider their genetic resources a national heritage resent the use of their germ plasm for profit in the industrialized nations, without monetary benefit to the countries of origin. Seed companies disagree, arguing that by improving seed they are adding value that must be paid for by someone.

"All sides of this issue have valid points," Henry Shands asserts. "The question is, how to work out an arrangement that is to the best advantage of everybody concerned." Such an arrangement is the present focus of several bodies. An international biodiversity convention that would establish a fund supporting conservation of important genetic resources, to be paid for by the users, is under discussion. There is an FAO undertaking addressing the issue of plant genetic resources. And the nonprofit Keystone Center is conducting an international dialogue on the subject, trying to achieve

These sunflowers at Plant Introduction Station, Ames, Iowa, are decorative; others are used for research.

a solution all sides can live with; their next meeting will be held later this month. "Somehow," Shands insists, "a compromise must be worked out, because it is for the benefit of all mankind."

It is clear that as developing nations move from subsistence farming to modern agricultural techniques, native varieties will give way to higher-yielding but far more uniform crops. Such genetic erosion puts all the more pressure on seed storage facilities, like the one in Fort Collins, to maintain as many volumes as possible in their genetic libraries. These seeds may well hold the key not only to our agricultural history, but to our future as well.

"Unlike the gold in Fort Knox, the genes in our seeds are perishable," says Eric Roos. "The bank is indeed a treasure, but it is also a very important responsibility. For if we don't have seed, we don't have agriculture, and without agriculture, there can be no civilization. The seed bank is the safeguard of civilization as we know it; maintaining it is a national trust."

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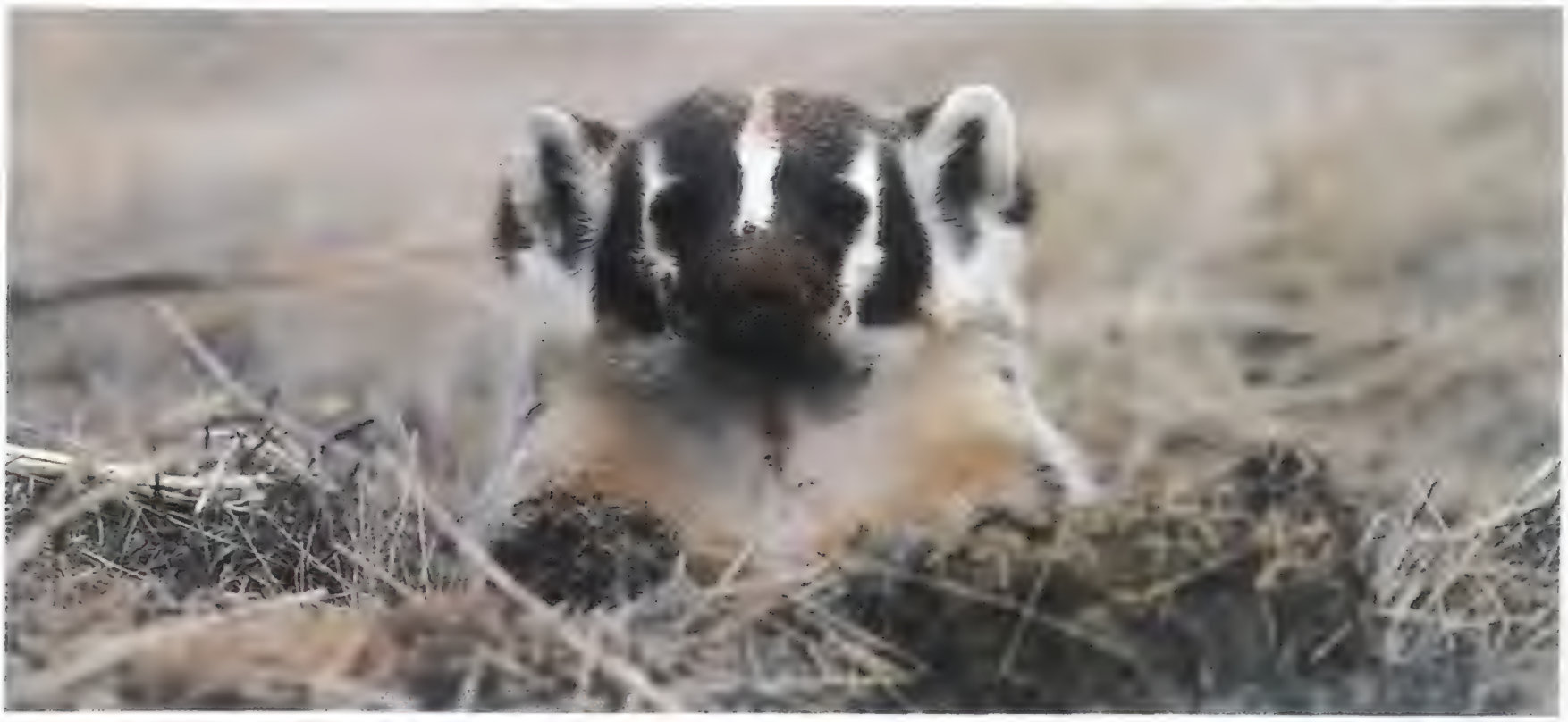
By Bil Gilbert

Mr. Badger can dig himself right into a hole, or out of one

He uses his paws and claws to shovel earth but, in life as in literature, it's his gritty character that gets him through tough times



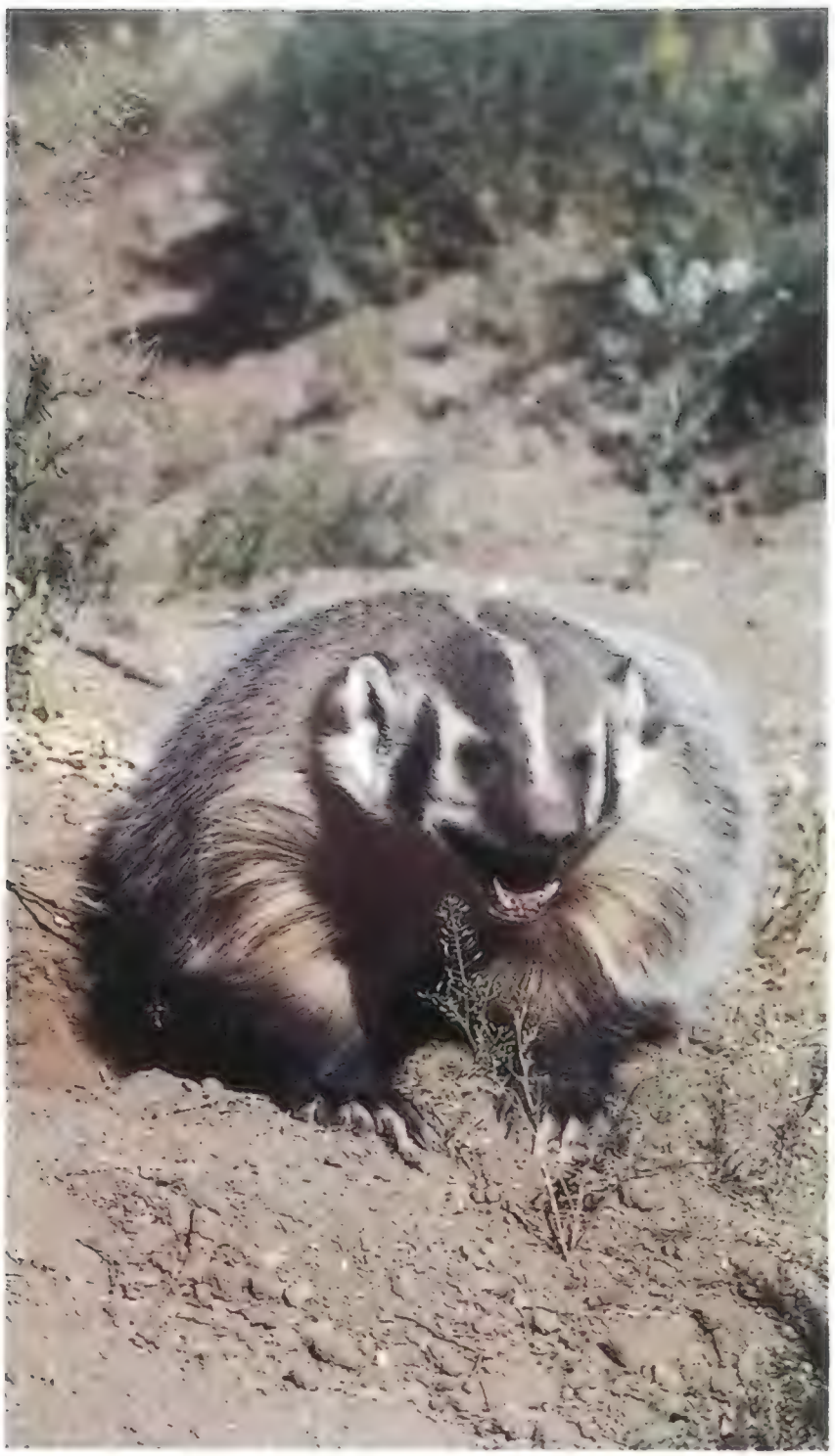
Snout plastered with dirt, a badger on the plains of Nevada interrupts its underground chores to size up an intruder. With its wedge-shaped head, short neck and strong legs, the animal is a made-to-order tunneler.

In the 1920s my grandfather purchased several hundred thickety acres fronting on a shallow lake ten miles south of Kalamazoo, Michigan. He intended to clear and improve some of the tract with beaches, docks, several tennis courts and a golf course. The remainder of the property was to be subdivided and the lots sold as sites for summer homes. The golf course was designed by my father, a newly graduated landscape architect then working in the Detroit area. Shortly after it was finished the stock market crashed and the Great Depression followed, leaving my grandfather without the means or inclination to continue the project, and my father without clients.

Consequently, when I was 4 years old my parents returned to the aborted lakeside development, winterized one of the three cottages that had been built but not sold and waited out the Depression there. In the summer they operated the golf course. During the winters my father hunted and trapped, but recreationally he was an avid amateur naturalist, much more interested in live animals than dead ones. His enthusiasms soon became those of my sister and myself. We were forever bringing in beasts to be doctored, fed or closely scrutinized. Variously fit and tame snakes, bullfrogs, turtles, rabbits, squirrels, raccoons, foxes, orphaned fawns and, on two separate occasions, black bear cubs, often were confined on or roamed freely about the premises.

One morning late in the summer of 1934, I was riding with my father in a truck on the golf course. At the seventh fairway we met a beast that was about the size and color of a raccoon but was shaped like a huge,

A badger's curved foreclaws, shown here slightly larger than actual size, are augmented on undersides by corpuscles that enable the creature to "feel" the soil as it digs. Webbed toes transform paws into scoops.



In no mood to back off, a badger confronts a human visitor. Loose skin makes it look much bigger than it is.

furred snapping turtle or sow bug. The muzzle of this low-slung mammal was marked with white bars and blazes arranged in a dramatic geometric pattern. Dangling from the corner of its mouth like a limp length of sausage was a gopher. My father braked the truck and yelled, "My God, it's a badger!"

By then those animals were very uncommon in southern Michigan. My father later said that only twice before had he even caught a glimpse of one of them, and my recollection now is that prior to that moment I did not know they existed. Naturally we were elated by the badger which, rather than running away, advanced toward the truck and, halting a few feet from a front tire, growled menacingly at it. Aside from this surprising behavior, the most extraordinary thing about the animal was its foreclaws, which we got a good look at: they were nearly as long as my fingers.

When it was satisfied that it had sufficiently intimidated the truck, the badger moved off to a low, sandy ridge and began to dig. There was a spray of sand and then it was gone, seeming to disappear into the ground as quickly and easily as a porpoise submerges below the surface of the sea. The hole it left behind was approximately the size and shape of a large watermelon split in half lengthwise. Obviously a creature of such prowess could play hell on a fairway or putting green. However, rather than considering how to remove it with a gun, trap or poison, my father decided to catch and keep it alive.

"I cannot describe the racket it made"

First he took a shovel from the truck and tried to dig out the badger. After getting four or five feet into the sandbank without seeming to gain any ground, he gave up that idea. Then he rolled a heavy-canvas tractor cover into a cone, placing the base of it over the hole, and ran hose from a nearby outlet into it. The valve was turned on and shortly there were gargling sounds followed by a wet badger. It staggered into the tarp trap, which was then folded tightly around it. In this straitjacket it was taken to a barn and put into a crib—a sturdy structure of oak timber and heavy wire mesh set on a concrete slab. There it began to snarl, hiss and gnash its teeth. I cannot describe the racket it made, but since then I have heard buffalo bellow, a lion roar and a grizzly growl. No other mammal I know sounds quite so ferocious as an outraged badger.

My father thought we should go away and let the creature compose itself. We returned in about an hour. The crib door—made of one-inch, rough-cut oak—was splintered as if somebody had worked on it with a crowbar. The badger was gone and was never seen again, perhaps having decided after its experiences of the morning that, no matter how many go-

phers there were, it could find a better hunting territory than our golf course.

Ever since then I have gone out of my way to look for badgers and to talk to people who are more intimately acquainted with them than I am. For this purpose I spent a few days last summer along the Snake River, southwest of Boise, Idaho, in the Snake River Birds of Prey Area. This 482,640-acre tract has been set aside by the federal Bureau of Land Management as a sanctuary for eagles, falcons, hawks and owls, which are more various and abundant here than in any other single section of the continent. The sanctuary also contains the greatest concentration of badgers ever reported in North America. Both raptors and badgers are attracted to the region by a teeming population of Townsend ground squirrels.

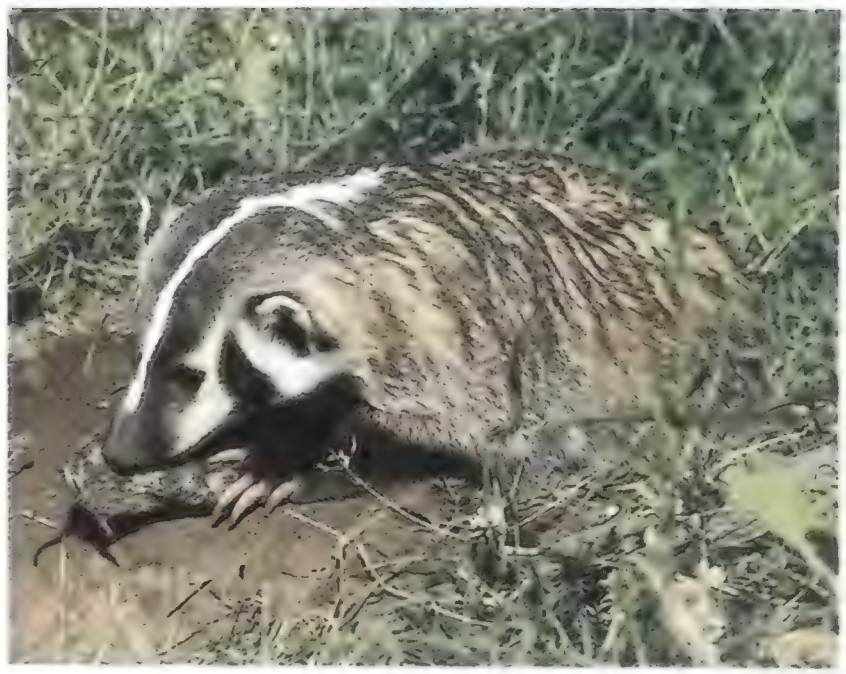
The plain above the river is gently rolling. The soil, a volcanic till, is soft and the cover, mostly sagebrush and bunch grasses, is sparse. Nevertheless, the walking is slow and somewhat hazardous because the surface is honeycombed with tunnels that badgers have dug for dens or in pursuit of squirrels.

Even a young one won't back off

In the late morning, sidestepping those badger works, I came upon what appeared to be a young male. Being grayish of color, badgers blend particularly well with sagebrush scrub and I was not aware of the animal until we came within 30 feet of each other. Hearing or smelling a foreign being, he turned to face in my direction, spread his bowed legs and took a stance somewhat like that of a down football lineman. Firmly positioned, he raised his muzzle, displaying the white markings, and began to growl and hiss but rather softly, having decided, it seemed, that the situation required only a moderate response. (In these circumstances I have always translated a badger's warning as: "Take another step, turkey, and you are dead meat.") After clearly delivering his message, he strolled off and disappeared into a clump of sagebrush where, I later found, he had dug a burrow.

A few days afterward I visited John Messick, an associate professor who is head of the biology department at Missouri Southern State College in Joplin. He said he had often been braced by badgers in the same way in the same area. I had gone to the Snake River plain on the recommendation of Messick, who was the first zoologist to document what good badger country it is. In the late 1970s, as a graduate student at the University of Idaho, he spent most of three years studying the animals there.

Messick originally wanted to do jaguar research in Central America but political turmoil made that impractical. He turned to badgers because they were



Badger gnaws on a mouse it caught in the Bitterroot Valley of Montana. The creature favors prairie habitats.

Unlucky snake writhes to avoid jaws of opportunistic predator. Badgers do most of their foraging at night.

Having made quick work of a prairie dog, one of its principal prey animals, a badger settles down to eat it.

Two young badgers play near their den. After a family group breaks up, siblings begin leading solitary lives.

handy and relatively unstudied. Though he selected them for pragmatic professional reasons, Messick grew to like badgers very much and now misses being able to mingle with them as he did in Idaho. As to what their emotional appeal is, he told me: "It is hard to explain. I associate the word 'character' with badgers but that is obviously very anthropomorphic."

As a scientist, Messick deals only with hard data and quantifiable phenomena and so he was uncomfortable with that soft, impressionistic comment. However, in regard to the history of badger studies, scientific and casual, his observation is a fairly conventional one. It has been variously described as courage, ferocity and spirit, but virtually everyone who has had much to do with these medium-sized carnivores agrees there is an unusual inner quality that makes them such formidable pieces of zoological work.

According to etymologists, badgers are so called because it occurred to early English-speaking people that their facial markings resembled badges of heraldry. Evolutionary biologists theorize that the prominent white blazes are an example of "advertisement coloration," a fairly common phenomenon. Gaudy colors, plumes or scales often seem to have evolved so that the bearers of them can make an impression on members of the opposite sex. Since North American badgers have very little to do with other badgers, however, it is thought that they have badges for the same reason that knights-errant emblazoned their shields with dragons and lions, or Indian warriors painted their faces: to give potential enemies pause.

Unlike rattlesnakes, skunks and other creatures possessing conspicuous features that identify them as animals with which it is dangerous to meddle, badgers have no obvious superweapon with which they can respond reflexively if challenged. Superficially they are no better equipped for massive retaliation than many other small- to medium-sized carnivores. This raises the question: If, as has been suggested, their vivid facial markings are warning "advertisements," what is being advertised? Though, as John Messick said, it may sound anthropomorphic, the most plausible answer is that the badges of badgers advertise their character, which seems to serve them as effectively as venom does snakes or stench does skunks.

By way of extreme example, consider the case of a 90-pound Doberman pinscher that until recently guarded a used-car lot owned by a Salt Lake City man. The Doberman's owner considered his pet one of the best junkyard dogs in the area. One morning this past summer, however, he was chagrined to find his pride and joy heavily engaged with a badger, and apparently getting the worst of it.

Alarmed, the man telephoned the Utah Game Department. His call was taken by Gene Weller, who deals with the wild animals—most often raccoons and skunks—that occasionally turn up in Salt Lake City and make nuisances of themselves. Weller responded promptly, but by the time he arrived in his pickup truck at the car lot, the Doberman was dead and partly dismembered. The badger was acting a bit groggy. "I thought," says Weller, "that the dog may have slammed him into a fence." Weller got a noose on him and put him in a cage ordinarily used for raccoons.

Arriving back at the office, Weller found the badger had demolished the wire raccoon cage and was in the process of ripping open the fiberglass cap that covered the bed of the pickup. With help from other Game

Dirt flies when a badger goes to work with its head down, hind legs braced and strong forepaws churning.

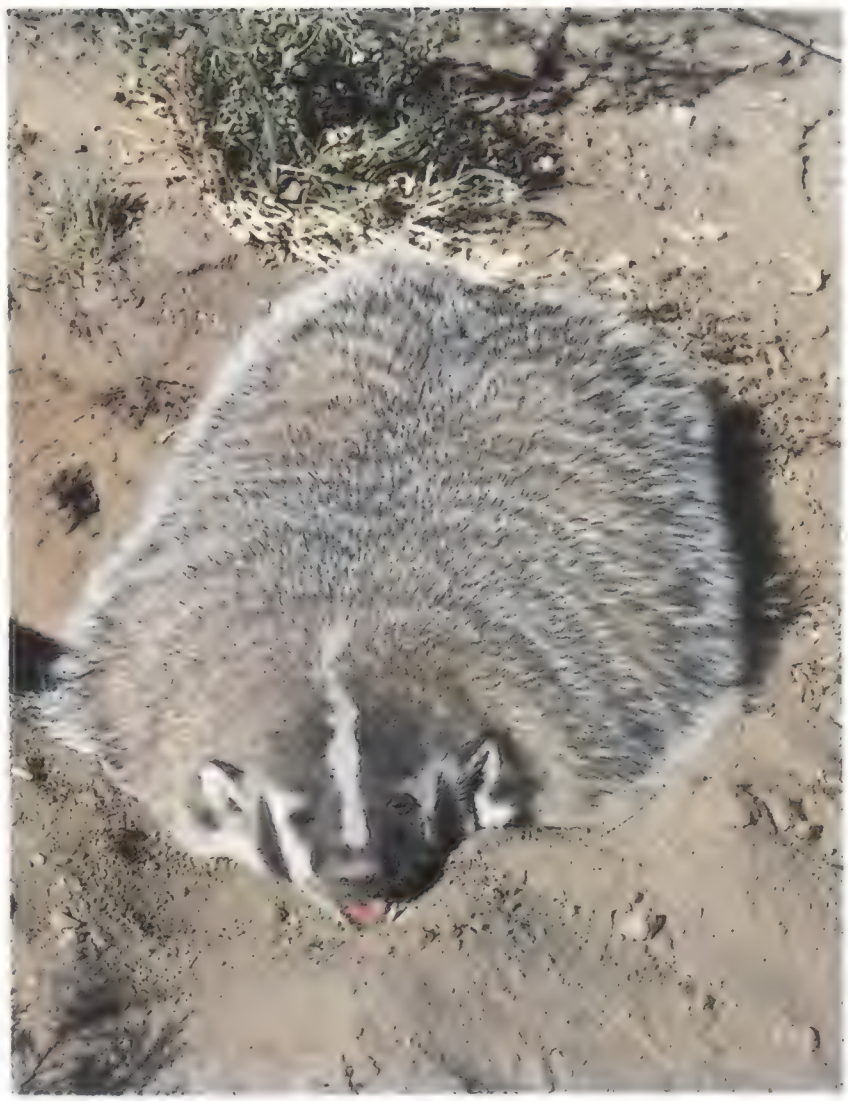
Department employees he eventually subdued and disposed of the injured animal.

There are a number of other reports of dogs challenging badgers that may be an indication of how domestication has affected their natural common sense. Occasionally they may overcome a young or handicapped badger but overall their record is very poor in these confrontations. Of the five dogs I know about that tackled badgers, four were badly lacerated and the fifth—a hound employed to flush peccaries from mesquite scrub and hold them at bay—was killed.

Badgers belong to the weasel family and like others of this clan are well fanged, supple and very muscular. (Wolverines, another stout-bodied weasel, and badgers are often cited as being the strongest mammals, pound for pound, in this country.) Badgers have a tough and oddly oversize hide, which hangs so loosely on them that it is sometimes said that they can turn around in their skin. This is an exaggeration, but the manner in which badgers are covered greatly enhances their ability to defend themselves. The first move of hunting canines or felines, for example, is to seize their intended victim by the neck or throat. Encased in what amounts to flexible body armor, a badger held in this manner will swivel around and begin tearing at the forequarters of its attacker.

These realities are at the root of a blood sport that reflects some of the more peculiar aspects of human, or at least British, behavior. Professing to find in badgers many of the virtues they most admire in themselves, British naturalists, folklorists and fictionists have praised and romanticized the animals. Few literary characters of any species are pluckier—to use a native expression—or more quintessentially British than the badgers who appear in Kenneth Grahame's *The Wind in the Willows* or T. H. White's *The Once and Future King*. So, fascinated by Mr. Badger, the Brits for centuries have been throwing him into small pits with dogs to display and test his pluck.

Since badgers and dogs are about the same there as here, certain arbitrary rules have been devised to make these matches more competitive than they naturally would be. Charles A. Long and Carl Arthur Killingley, whose *The Badgers of the World* is a definitive zoological text, described a traditional British badger baiting. "The captive badger is held within the confines of a restricted space and is then subjected to repeated attacks of specially bred dogs, one at a time. . . . To give advantage to the dog, the badger is handicapped in the first instance by being secured by a chain. . . . Should this prove ineffectual in preventing the dogs from getting mauled . . . the leg, or legs, of the badger may be broken. . . . The lower jaw of the badger may also be shattered . . . or sawed off."



Looking like a big, hairy sow bug, a hunkered-down badger shows off its distinctive fur coat to good effect.

Since 1973 the badger in Britain has been a fully protected species, but there are reports that illegal dog-badger fights are still staged by fanciers of the sport. Badger baiting has never caught on in the United States and generally Americans have been less imaginative than the British as regards both abusing and extolling them. The body of badger arts and letters in this country is small and of poor quality. Nor, beyond providing a nickname for a state, have badgers had much influence on our folk history. (In the 1820s lead miners from Missouri and Illinois moved into the Wisconsin territory. They not only worked in tunnels but lived in hillside dugouts, and it occurred to some pioneer wit that their behavior was very badgerish. As has been the case with Sooner, Tarheel and other initially derisive names, this one stuck and was applied to other residents, who in time became proud to be citizens of the Badger State.)

Overall, relations between people and badgers in North America have been adversarial but only sporadic, since neither species has needed or wanted to

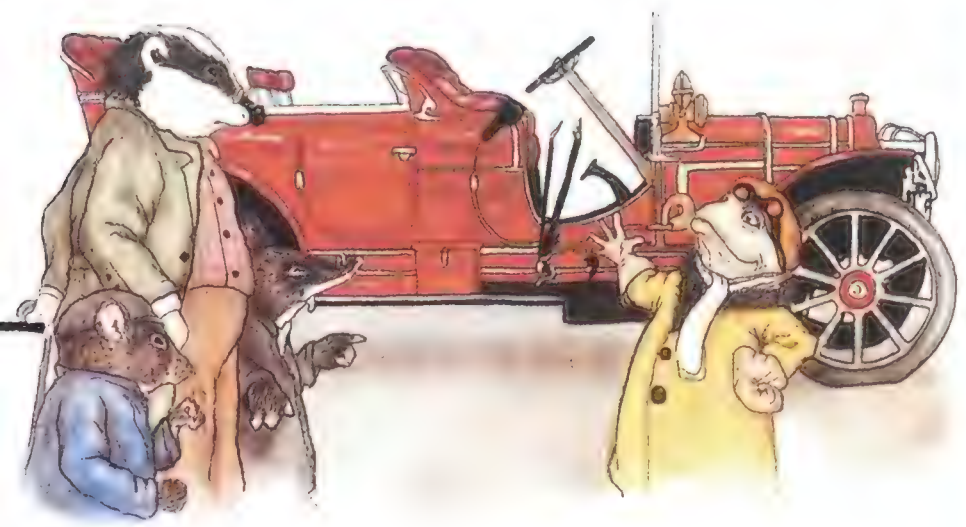
Bil Gilbert is a frequent contributor. His book about Tekamthi (Tecumseh), God Gave Us This Country, *was published last fall by Atheneum.*

have much to do with the other. In the western two-thirds of the United States and Canada—the badger heartland—the animals have in the past been treated and often bountied as varmints, principally because their diggings when hidden in the grass or brush can be rather effective traps for horses, wagons or people. Because of their unusual size and markings, tanned badger hides are sometimes fancied as wall or hearth decorations, and badger hair is occasionally used to trim garments of finer fur. There has never been a large market for these coarse pelts and consequently badgers are of only marginal interest to trappers.

Automobiles and highways are clearly the most serious human threat to this species. Of the 51 dead badgers found by John Messick in Idaho during a three-year period, 30 were road kills. (Local residents trapped or shot 15 animals, while the other 6 died of unknown or natural causes.) Elsewhere, too, badger carcasses are fairly common along western highways. Beyond being nocturnal and rather slow-moving creatures, temperament may be a reason why they are especially vulnerable. The behavior of the first badger I met—the one who challenged my father's pickup truck—was not unusual. There are a number of reports to the effect that aroused badgers see no reason why they should give way to automotive vehicles. They have been known to show the same contempt for, among other things, horses, bulls and bears.

Very occasionally golden eagles, ravens and coyotes are able to take badger cubs but, except as noted for foolish domestic dogs, no other species can—or is inclined to—try to prey on adult badgers. For their part, badgers are top-of-the-food-chain hunters that kill or eat more or less everything they can get their jaws on. They consume considerable quantities of insects including the larvae of bees, wasps and ants, whose nests they rob with impunity because of their thick, loose hide. Badgers have no reluctance about entering the water and have been seen catching frogs, crayfish and carp in shallow lakes and streams. They take ground-nesting birds, bird eggs and young whenever they can get them. They eat lizards and snakes after, it has been observed, severing and putting aside the heads of venomous ones. Their mammalian prey includes moles, shrews, rabbits, armadillos, porcupines, raccoons, and fox and coyote pups that they dig out of breeding dens. Badgers are generally fresh-meat eaters but sometimes feed on carrion, which has probably led to undocumented stories that they are lamb and calf killers. Mice, rats, gophers, prairie dogs and various ground squirrels constitute the true staff of life for badgers, which are generally abundant only where these burrowing rodents are.

Along with their flattish figure, powerful shoulders and big claws, badgers possess other physical assets that make them, among mammals, the most specialized and efficient fossorial hunters. Like birds, they have a transparent inner eyelid (called a nictitating membrane) that enables them to see while working in loose sand or grit. Their big forepaws are webbed at the base and are used like shovels for moving and throwing



Through the years, illustrators have had great fun portraying Mr. Badger in various editions of Kenneth Grahame's classic, *The Wind in the Willows.* In 1959 (opposite), Ernest Shepard showed him leading a raid to retake Toad Hall from its captors. In 1980 (above), Michael Hague made his pudgier version look unhappy over Toad's latest infatuation. In 1940 (right), Arthur Rackham's kindly Badger lent Mole and Rat dressing gowns when they turned up at his place one wintry eve.

dirt. Located on the undersides of the foreclaws are sensors that apparently enable the animals to feel small obstructions and changes of composition in the soil through which they are digging.

Badgers do most of their hunting at night, shambling through rodent colonies, sniffing, listening, occasionally making test holes. When they have located their quarry, they may tunnel after it but often save themselves work by digging directly into the compartment where the rodent is hiding. To keep up their strength, adult badgers must consume something on the order of a prairie dog—or its equivalent in smaller ground squirrels or other prey—a day.

When not hunting or eating, badgers spend most of their time in their own dens, perhaps grooming themselves and napping. In bad weather they may plug up their tunnels from the inside so as to protect against snow and drafts, and sleep for several days on end. However, they need and are able to hunt throughout the winter, most commonly digging out rodents that, unlike themselves, are true hibernators.

North American badgers have virtually no social life. Adults of both sexes are solitary, occupying fairly large (up to 2,000 acres) and sometimes overlapping ranges. Except during midsummer, when males roam about looking for females, badgers seem to avoid one another and if they accidentally meet, the confrontations are usually belligerent ones. There is very little of what can properly be called courtship among badgers. Their matings are brief and then the two animals go their separate ways. Though breeding occurs in summer, badger embryos do not begin to develop in the womb until the next winter. (This phenomenon, called delayed implantation, occurs among other, but not all, members of the weasel family, and among certain other mammals as well.)

The young—usually two or three per litter—are born in the spring. After several weeks of nursing, they begin to eat solid food that is brought back to the den by the female. In late spring they emerge and forage together with their dam. However, the period in which they enjoy maternal protection and instruction is exceptionally brief. As early as mid-June these families break up as the young either voluntarily leave or are driven off by the adult females to seek territories of their own. Some cubs find nearby home ranges and ready-made dens whose previous occupants have died or relocated. However, John Messick knows of one

European badger ambles through the brushy English countryside. More sociable than its American cousin, this species of badger is also more settled. An extended family of a dozen or so may share a "village" of burrows, which they will collectively defend against outsiders.

young animal that traveled nearly 70 miles before it located a suitable empty territory.

The badgers of North America and their European counterparts are similar in general appearance but the latter are notably social—in fact, communal. Occupying extensive mazes of interconnected burrows called setts, a dozen or so European badgers may live together amicably in extended groups that include individuals of both sexes and various ages. Members of these communities do not hunt cooperatively (earthworms are the major food of this species) but they will collectively defend their territory against intruders. They also groom and play together affectionately.

It has been admiringly noted by Britons that their badgers are mortally stubborn about clinging to their home digs. As a matter of historical record, a number of badger setts have been in use for more than a century and archaeological evidence indicates that one of them, a complex of tunnels in the Mendip Hills of Somerset, has been more or less continually occupied for 60,000 years.

Worldwide there are six species of badgers, inhabiting parts of Eurasia, Africa and North America. The ancestor of them all is thought to be a martenlike creature that originated about 40 million years ago in Southeast Asia. The progenitors of North American badgers came to this continent across the Bering land bridge from Siberia two to five million years ago. During the Pleistocene, as glaciers ebbed and flowed, causing periodic changes in the climate and flora, badgers extended their range, according to fossilized remains, at least to Maryland and Pennsylvania. However, when the eastern third of the continent became heavily forested, the species retreated to more-open country and in historic times has been found only from the Great Lakes region westward.

Presently badgers seem to be prospering, having taken advantage of certain recent changes in human behavior. Some of the natural and social history of southern Michigan is illustrative. When the first white settlers came into this territory, badgers were common, inhabiting grassy glades (locally known as oak openings) that were interspersed with forests. By the 20th century most of these prairie tracts were being farmed or had been developed in other ways that rendered them unsuitable for badgers and the various species on which they preyed.

Remnant populations survived in out-of-the-way places, but as varmints the animals were under constant predatory pressure from humans. My grandfather, for example, was seldom abroad without a shotgun and fully subscribed to the views of Cotton Mather, the Puritan divine, who postulated, "That which is not useful is vicious." Had I been with him, my first encounter with a badger would almost certainly have been much different and briefer.

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By clearing the golf course site and turning it into a permanently turfed area, my family inadvertently created 60 acres that were the ecological equivalent of the original prairie and—after the gophers came—splendid badger habitat. The one who tried to exploit it in 1934 probably had been born that spring and had traveled a considerable distance in search of a good territory. The fact that the golf course had been in place for six years before a badger found it, and that none came after the first one, is an indication of how scarce the species then was.

After World War II my grandfather sold the golf course and the new owners closed it. For reasons that do not pertain here, very little has since been done to the property and it is now covered with a dense, 40-year-old scrub forest. I no longer live in the area but when visiting sometimes bushwhack through the underbrush looking for the outlines of old tees and greens. I have not seen a gopher in those thickets for years, and the only badger sign, the slight depression in what was the seventh fairway, is so ancient that I am now probably the only one who can recognize it.

There are no other places I know of in the vicinity that are wilder, brushier and less developed now than they were 50 years ago. Elsewhere in Kalamazoo County (which has more than tripled its population in my lifetime) there is much less farmland, woods and wetlands, and more commercial, residential and recreational land. Most noticeably, there has been a great increase in the acreage planted and maintained with grass along highways, around business establishments, public facilities and private homes, and in parks, scenic areas and playing fields.

Assessing the overall consequences of this prairification process is, I think, beyond us, but in the short term it appears to have been a boon for badgers. Though no formal survey has been made, the number of badger reports and road kills has convinced state biologists that the species is now more abundant in southern Michigan than it has been for a long time. This opinion is shared by, among others, public animal-control officers, who have to deal with complaints about badgers that have moved into grassy, rodent-rich sections of the exurbs and suburbs. Because of this presumed population increase, the species was removed in 1989 from the list of fully protected Michigan mammals and was reclassified as a game animal that can be trapped legally in designated seasons.

The new regulation might be unpopular with preservation-minded individuals and groups, the numbers of which are indicative of how attitudes about wildlife have changed since my grandfather's day. Well aware of this new sensitivity, state game officials say that they will carefully monitor the trappers' take and adjust it—in accordance with up-to-date principles of wildlife management—so that there will always be enough badgers for the citizens to enjoy but not so many as to create a nuisance.

Elsewhere there have been similar developments in our use of the land, and wildlife and badgers have responded in much the same fashion. In the plains and mountain regions of the west, where the animals have always been the most plentiful, their populations are thought to be, at the very least, stable. On the eastern

In a flowery field, a badger appears downright pacific but it is intent, no doubt, on locating its next meal.

fringes of the species' range, in Missouri, Illinois and Wisconsin, as well as in Michigan, badgers are flourishing in areas where they previously have been scarce and are reoccupying territories from which they have been absent for decades.

From the perspective of badgers, people and glaciers are probably quite comparable. We may work more frenetically, but like sheets of ice we periodically create and eliminate opportunities for the animals. Being tough, adaptable survivors, they have waited out the bad times and smartly exploited the good ones. The phenomenon is stylishly discussed in a passage of the aforementioned *The Wind in the Willows.* Chatting with Mole, Mr. Badger explains that his commodious sett has been made among and from some of the ruins of what was once a great city. Astonished, Mole asks what has become of the original builders.

" 'Who can tell?' said the Badger. 'People come—they stay for a while, they flourish, they build—and they go. It is their way. But we remain. There were badgers here, I've been told, long before that same city ever came to be. And now there are badgers here again. We are an enduring lot, and we may move out for a time, but we wait, and are patient, and back we come. And so it will ever be.' "

Admittedly, Mr. Badger is the hero of an anthropomorphic fantasy and British to boot, but he seems to be a sound natural historian and a plausible futurist.

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Students Casey Toso, Peggy Stone and David Stepan review their notes between classes at the FAA Academy.

By James R. Chiles

At air traffic control school, it helps to memorize in your sleep

The mural propping them up commemorates the 50th anniversary of the profession, observed in 1986.

Tacking airway maps everywhere—even on the ceilings above their beds—students live and breathe a '3-D chess game' for two months

In 1857, a 21-year-old by the name of Sam Clemens, later known to the world as Mark Twain, signed on as a cub pilot aboard the steamer *Paul Jones.* During his apprenticeship, Clemens had to memorize all the landmarks along 1,200 miles of the Mississippi; then the river's appearance at night and in fog; then the river's channels in flood and drought. Clemens complained at one point that all this learning would make his head so large he'd be "stoop-shouldered."

"You only learn *the* shape of the river," his instructor Horace Bixby told him, "and you learn it with such absolute certainty that you can always steer by the shape that's *in your head,* and never mind the one that's before your eyes. . . .

"When I say I'll learn a man the river, I mean it," Bixby said. "And you can depend on it, I'll learn him or kill him."

Not just your average 9-to-5 job

Horace Bixby's spirit lives today in the halls of the Federal Aviation Administration Academy in Oklahoma City. There comparable mental prowess is being demanded of those entering an occupation unforeseeable in Clemens' time: air traffic controlling. Controllers use the analytical talents of a chess grand master, the mental calculations of a mathematician and the terse language of a police dispatcher. They're taught to perform their jobs with the cool assurance of a bullfighter.

The Federal Aviation Administration (FAA) takes people, many with no aviation background, and filters out two of every five hopefuls in a rigorous screening program in Oklahoma. Nearly three years of on-the-job training follow before a trainee can be trusted to take charge of a radar screen full of airplanes. "A controller has to make thousands of life-and-death decisions," says Doug Murphy, deputy superintendent of the academy. "The only thing we require is that he make the right decision, every time."

The job of a controller is to take aircraft flying under instrument rules and give them safe passage to their destinations, using radar contacts and radio transmissions. Pilots have no clear picture of what nearby airplanes are doing, so they depend on controllers to keep them apart.

Here's what makes the job difficult: in many parts of the country and at certain hours of the day, there's not nearly enough room for all the planes to pass through whenever the pilots would like. Sometimes there aren't enough controllers either; the system is still recovering from the controllers' strike of 1981, when firings reduced the ranks by two-thirds. The current total of experienced controllers is 3,000 less than the prestrike figure of 13,000. The FAA does have more controllers

Photographs by Enrico Ferorelli

The rigors of air traffic control school

in training now, and the total of experienced and novice controllers is about what it was in 1981. Meanwhile, air traffic has increased by approximately 9 to 12 percent. Controllers work a lot of overtime, and use help from computers, to keep up.

Concern about whether the system is safe peaked in 1987, when near-misses between controlled airplanes passed the 1,000 mark. The figure has dropped by a third since then. A survey last year of 5,000 controllers and supervisors found that most believed the system to be "adequately" safe, although overloaded during rush hours. "There's room for improvement," says Dick Stafford, an FAA spokesman.

It's during those rushes that the FAA's overworked computers are most likely to misbehave. For 17 minutes during a weekend-traffic rush in mid-October, controllers at the Dallas/Fort Worth International Airport had to contend with a computer that scattered false numbers and symbols among the real airplanes on their radar screens. This incident followed an operator's attempt to prevent an overload on the system. Another tense moment came in early November when a communications breakdown at the en route air traffic control center in Leesburg, Virginia, prevented controllers from using their computer terminals to hand off flights to other controllers electronically. With quick help from their supervisors, they handled the transfers by telephone instead.

From the earliest days, air traffic controllers have had their hands full. In 1937, tower controllers in Akron, Ohio, complained about having to deal with baggage, sell tickets and answer the phones. Just after World War II, a reporter visiting the control tower at National Airport in Washington, D.C. found the senior controller looking out the windows with three microphones in his hands and ten loudspeakers going at once. The tower was responsible for 600 to 700 takeoffs and landings daily. The controllers' many shortwave radios pulled in everything from the chimes of Big Ben in London to coded transmissions from submarines. "During thunderstorms the bedlam is inconceivable," the reporter commented.

At this time, about 1946, all en route planes were plotted by map and secondhand radio contact. Nationwide radar tracking arrived the following decade, spurred by a rash of aircraft collisions. In the worst disaster, 128 people aboard two airliners died in a crash over the Grand Canyon in June 1956. Five months later, the Civil Aeronautics Administration ordered 23 long-range radar sets to cover the areas of highest air traffic concentration.

For all their responsibility and their improved radar equipment, today's controllers have only a small bag of tricks. Working out of airport control towers and en route traffic control centers, they can hold up takeoffs

Jim Chiles wrote on flying cars in February 1989. A licensed pilot, he is still intimidated by the machine-gun pace of controller talk.

Student enters a quiz answer into keypad; it rests on Aero Center map, which all must totally memorize.

High-tech teaching: the instructor can "talk" with each student via the small screen on their keypads.

to prevent overloads; they can reroute planes in flight; they can put airplanes into holding patterns; and they can order changes in altitude and speed.

Bringing a person into the system takes more than three years. The first step is a standardized written test that measures memory, mathematical ability and visualization. A score of 70 is passing, but under current practice, the FAA offers few people who score below 85 the opportunity to take the next step: security and medical checks, and face-to-face interviews. Those who make it this far receive an offer to spend two months in the screening program at the FAA Academy. The agency pays all of their expenses, and a salary besides, during this time.

It's 3:30 on an icy January afternoon and schools are letting out all over Oklahoma City. But this class at the FAA Academy is just starting: 18 hopefuls have gathered for their first day of instruction in the screening program. They won't leave until midnight; they happened to draw the late shift at a school that operates on two shifts.

Every brown Formica-topped desk is occupied. The atmosphere at the outset is almost prim: ties are snug against collar buttons, the curriculum notebooks are stacked spine to spine, and when the two instructors step forward, all eyes follow.

The instructors, Ray Kellogg and Steve LeGrand, explain that they will be with the group for the next eight weeks. Both are experienced controllers. LeGrand, who served six and a half years in Alaska before he came back to the academy, has the boyish demeanor of a graduate student. Kellogg is middle-aged; with his thinning hair, blue military-cut shirt and stern Arkansas inflection, it's possible to imagine him as a colonel briefing navigators before a bombing mission.

There will be little opportunity for daydreaming in here, though. Only a few minutes into class, Kellogg gets the students' undivided attention by describing how 40 percent of those who enter the screening program don't graduate. "The course is not all that hard," Kellogg tells them. "College chemistry is harder. But we give you very little time."

During the first month they learn the basics of controlling: aviation regulations, weather, radio naviga-

tion, communications and how the airspace has been carved up. That classwork doesn't actually teach the students how to take charge of real airplanes, but it does teach them enough so that the academy can test their abilities the second month in the "lab." There they encounter a sort of three-dimensional chess game.

Even late into the night, the students' attention never seems to fade. I notice that when LeGrand, in a moment of impishness, makes rabbit ears on the projection screen while Kellogg is a few feet away talking continental control zones, not a single student appears to notice.

When Kellogg polls his students, most list no experience in any aviation job, but several worked as controllers for the Armed Forces, including one of the two women in the class (about 16 percent of the students in the screening program are women and that number is on the rise). One man was a helicopter instructor pilot in the Army. Two men describe their most relevant experience as flying radio-controlled airplanes. One young man from Tennessee announces that he has never ridden in an airplane.

Controlling, like football, is a young person's game. Statistics say the average student is 26 years old and has some college but no aviation experience. The ideal age, says FAA research psychologist Pam Kegg, appears to be 22. Those over age 30 need not apply.

Closest to my stool in the back corner is Scott Stafford, mustachioed and erect, a briefcase by his side. He tells the class that he was an investment broker from Florida before he became interested in controlling. From his words, I guess that his presence here must be some kind of whim.

"Nothing else I wanted to do so much"

I learn later that night, as ties are loosened during a coffee break, that I am wrong: Stafford has traveled a long path to take this seat. He explains that he was at the academy two and a half years earlier and failed by a fraction. "I realized then that this is what I really wanted to do," Stafford says of his first attempt. "There was nothing else I wanted to do so much." Told that his only chance of getting another try was to take an interim job that would give him some aviation experience, Stafford turned his back on his financial training and spent a couple of years on the tarmac at the Fort Lauderdale, Florida, airport, washing and fueling airplanes. He earned a pilot's license, taking lessons at a nearby field. He is lucky; very few washouts are allowed back for another reach at the brass ring.

As an old hand, Stafford is primed for the academy's first hurdle: learning an airway map called Aero Center, which he'll have to draw from memory in a week. The map depicts an imaginary en route control zone

In an intense lab exercise, students play air traffic controller to "ghost pilots," who are fellow students.

loosely based on the airspace over the state of Oklahoma. I'm surprised to find that all the first-time students I ask are already memorizing it, even though Kellogg and LeGrand have not yet mentioned the map. Some started studying two days ago, when they received the map in their packet. Two students tell me they wrote to the academy's bookstore before coming to Oklahoma, to buy a copy and start work.

Throughout the country, controllers share the memory of this weblike map. Say "Slick" to a seasoned controller and he'll probably be able to tell you that it was the intersection of airways Victor 4 and Victor 5. "I'd venture to say that any successful controller could draw that map years later," says Jack Kelley, who passed through the screening program in 1985.

I count 21 named intersections on the map; 16 airways; and more than 300 radio frequencies, altitudes, compass bearings and mileages. Everything on the map must be memorized. "That's the one thing they really have to master," says Kellogg. "In a week everything's going to depend on that."

How to absorb all this minutiae? Students draw the map again and again. "I drew it every day," remembers Kelley. "I got to where I could draw it in 20 to 25 minutes." They tape copies all over their apartments: doors, kitchen walls, even the bedroom ceiling. One graduate tells me that his apartment complex had an Aero Center map in its laundry room. Laurel Pearson, a student in the second month of the program, says that she and her roommate wove a "string art" representation of the map for their wall. "Victor 9 was pink," she recalls about one airway.

"And you memorize a lot faster when you're afraid," says student Steve Rogers during a break. Rogers, like most, gave up a job to come here. Many left families at home, and spouses who were no doubt somber at the

With the flight strips arrayed in front of her—each providing the relevant data for an en route airplane—Mary Lynn Duncan pauses to visualize the total picture before issuing more instructions to the ghost pilots.

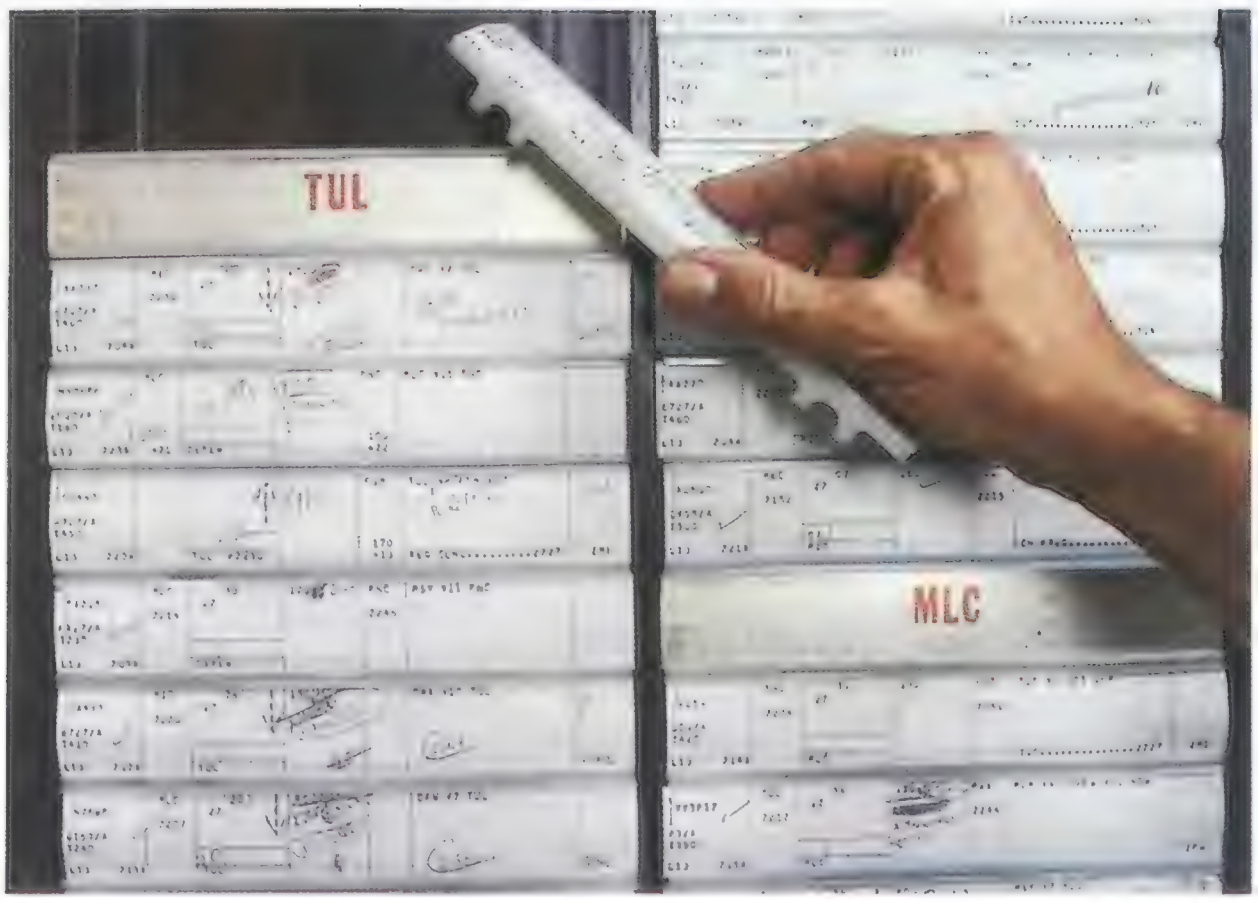
prospect of more than two months of unaided child-rearing. A student who fails will have to explain to that frazzled spouse that he or she won't be eligible for the $60,000 annually that a talented controller can make after three years of training.

As the next day of class begins, Kellogg has the group unfold their maps. He methodically explains every marking, assuming no prior knowledge of anything aeronautical. "A lot of new arrivals don't know a VORTAC [a navigational aid] from a haystack," recalls graduate Jack Kelley. This group will emerge from the classroom in four weeks and go into the laboratory. At Oklahoma City, the word "lab" evokes about the same dread in a student as an owl does in a field mouse.

Despite the name, with its suggestions of instruments and computers, the laboratory has no equipment more complicated than microphones and tape recorders. Here, students receive simulated air traffic control problems of steadily increasing difficulty that stretch their developing abilities to the limit. Most are practice problems, to get them ready for the six final problems that controllers say are the most difficult tests they've ever taken. "I've seen people in tears," says controller Robert Pfeifer, who attended the academy in 1986. "I've seen people resign in there."

What's so tough about it? In each problem, a student receives a small stack of strips holding the flight plans of imaginary aircraft that want to go down the Aero Center airways from someplace to someplace else, departing, crossing over or arriving at a certain time. For a half-hour, the student has to issue clearances and instructions for each plane and keep track of all the movements, to make sure the airplanes don't get too close to one another or violate a host of regulations. Some potential conflicts are built in, and the students will have to recognize and prevent them. Everything is done mentally. No pictures of any kind—models, sketches or computer screens with simulated radar images—help a student keep the planes straight. All he can do is arrange his flight progress strips: make a mark here, or set one on edge there, to alert him of a problem. In the final problems he'll have to juggle 20 planes at a time, moving in different directions and at different speeds and altitudes.

Controllers have a term for this ability; they call it



During a lab exercise, a student arranges his flight strips into a manageable sequence. The crux of air traffic control screening is this: Can the trainee juggle planes with varying directions, speeds and altitudes so that all of them will arrive safely?

"getting the picture." It's the mystical side of the job. Controllers, otherwise a chatty group, have difficulty describing how they do it. Few mention anything about seeing a sort of video-game image in their minds. But they agree that if you crept up behind an experienced controller sitting in front of a radar screen at evening rush hour and slapped a blindfold on him, he'd be able to call out the position, speed and altitude of every plane he was responsible for.

Students explain that memorizing the original Aero Center map is key in developing their visualization skills. "Remember, inlaid on our minds is that map," says graduate Stephen Glowacki. "I'm living in the picture. I'm a part of it and it's a part of me." Also of assistance is the fact that planes don't wander freely across the map, but travel down defined airways and pass familiar checkpoints spaced at known distances.

One way to understand how the "picture" works is to think of your own home, where you know every room and hallway and piece of furniture. That's your map. Now imagine setting out a dozen windup toys in various rooms and letting them go. If you were responsible for telling someone else when to pick up the toys to keep them out of trouble, you would think about each toy in turn, updating yourself on its expected progress, while giving extra thought to those that might be nearing collision or other mischief. A fire engine approaching the basement stairs, for example, should claim more of your attention.

I get the chance to sit through two practice problems in a lab one morning. This particular group of 14 students, 12 men and 2 women, is just four days into the laboratory phase. There's little to distract the eye or mind in this room: chalkboards, checkered green linoleum, masonry-block walls. Layers of gray sprayed insulation above head level, reaching all the way to the high ceiling, give the room a slightly cavelike appearance.

The room holds two rows of beige consoles. One row is for student controllers, and the other row is for students acting as "ghost pilots" who follow minute-by-minute scripts to simulate a multitude of pilots. Instructors with headsets stand in the aisle. High above each student's seat is an Aero Center map to consult if memory fails; directly in front are a microphone, a row of intercom switches and a rack to hold the computer-generated flight progress strips that represent each airplane in the problem. These paper strips are printed with expected departure or arrival times, speeds, altitudes, aircraft identifiers and three-letter map-route references.

The overhead lights dim, signaling the start of a 20-minute preparation period to read, mark and sort the flight progress strips. So that controllers always will be able to understand one another, this marking must be done the academy way. A red "W," for example, always means that one airplane's planned route will bring it too close to another plane.

Then the lights go up and the problem begins. Ghost pilots request clearances and answer requests for their positions; the student controllers, who all have identical flight strips, pursue their own solutions for

managing the airplanes. Observing the action is a little like attending a convention of mind readers, because everybody in the room except me knows what these imaginary planes are doing. The lab instructors, one to each student, have to maintain the mental picture of their student's airplanes, so as to keep track of the mistakes. An instructor also will note whether the student was confident enough to put all his airplanes into the air, or kept some on the ground as a way of simplifying the problem.

In a low and somewhat hesitant voice, the student nearest me issues clearances and directs planes into holding patterns. I hear him give several orders to disregard his previous instructions. His instructor leans over to whisper to me that airplane "November 326 Romeo" is on a collision course.

Afterward, the instructor tells the student he committed nine "separation" errors, meaning that he directed that many planes too close to one another or into some forbidden airspace. "They're going down like dominoes," is the instructor's crusty conclusion. Nobody in the room goes blank this morning, but I'm told it's not unusual. "During the first two or three practice problems," says Robert Ulmer, supervisor of the academy's laboratory program during my visit, "if the instructor asks them their name he'd be lucky to get an answer." When an instructor sees a student staring vacantly at blinking intercom lights, he'll urge the student to do something, even if it's wrong.

The one thing that nobody expects in the laboratory is a perfect score, because the problems are designed to stay ahead of the students' quickly developing abilities. "We're not looking for perfection, but for potential," Ulmer says.

That almost-impossible perfect score

The final obstacle at Oklahoma City is a two-hour written test. Written tests account for 40 percent of a student's final grade; the six laboratory problems make up the rest. At the end of the course, a grand total of 100 points is possible, but no first-time student in the history of the present program—30,000 students since 1976—has gotten higher than 98 points.

The figure on students' minds is "70." Anything below 70 points is failure, pure and unequivocal. This is no college, in which a student can linger an extra year to tally enough credits to graduate. The morning after the last exam, everyone receives his or her average, figured to four decimal points. Those with fewer than 70 points trudge down the hallway to check out. The rest return to class to make arrangements for job placements and a short postgraduate course at the academy. Graduates are separated into two groups: those going to airport control towers and those going to en route centers (there are 21 of them around the country). En route centers and busy airports have first dibs on the highest scorers. Even safely out of the academy, failure remains a distinct possibility over the next three years of field training. About one out of six who begin field training won't receive the title of Full Performance Level controller.

At the en route centers, which have their own training departments, there are more maps to memorize, more classes, and more simulated airplanes to control. About two months after arriving, trainees begin their work in the control room as apprentices. They deliver flight progress strips to experienced controllers and help enter certain flight-plan data into the computer.

At the Fort Worth en route center, the control room is a dimly lit chamber about two stories high, with four long rows of consoles holding large, round radar screens. Each screen shows only a small part of the entire control area, and controllers constantly hand off flights to their neighbors or accept flights from them. A plane appears as a glowing green block of letters and

In tower-controller lab, students move planes on the airfield as another, in red jacket, calls the shots.

The rigors of air traffic control school

numbers. At busy times, controllers talk in a nearly unbroken stream, delivering messages that usually last only a few seconds each.

After more classroom instruction, trainees come back to the control room as assistants to the full controllers. They arrange the flight strips and use the intercom to talk with other controllers as planes move between sectors. After passing tests as assistants, they go back to the academy's radar simulator facility, where they begin to issue clearances like full controllers.

Finally, the trainees take seats at real radar screens and give clearances to real pilots. Instructors watch keenly; in fact, trainees' major mistakes go onto their instructors' professional records. The trainees have to work under a variety of conditions, including very busy periods, because this is the only way the FAA can know whether they can handle the job.

Tony Brescia (opposite), an area manager at the Fort Worth center, describes the kind of situation an experienced controller must be able to handle: a center is funneling long lines of aircraft into a major airport at rush hour; then a call from the airport comes, saying that it has some kind of emergency and can't accept any more airplanes. In controller language, it is called "closing the door." A controller working the arrival traffic has to unleash a torrent of clearances to change all his airplanes' directions and organize them into safe holding patterns in an area already crowded with other planes. "You always have an alternate plan," Brescia says. "Like a good running back, when one hole is blocked you look for the next."

Why do people sign up for a job with so much responsibility and pressure? "It's fun," says Tom Lusch, a controller at the Cleveland, Ohio, en route center. "When you're working you have to focus all your energy on the task," he says. "You get a good feeling out of knowing you did it well. And you can see the results right away." A certain personality seems attracted to the work: assertive, outgoing and confident. "I look for the ones who, when you go up and say something, they'll give you a sharp answer right now," says instructor Ray Kellogg. "It might be wrong, but I can teach them the right answer later."

Kellogg adds a warning about the high salaries. "It's not a good idea to go in with the idea of the big pay—not if you hate the job. The money's not worth it. For one thing, you're not going to have an ordinary life. With our hours, it's hard to be a scoutmaster." Controllers work around the clock in shifts, and every one will have to take the midnight shift regularly. Many work overtime to make up for staffing shortfalls.

Even as it builds up the ranks of controllers, the FAA is contemplating how it might give the job to computers instead. One proposal anticipates a fully computerized air traffic control system within 20 years. Computers would handle routine routing decisions and even "talk" with the pilots; humans would be standing by only to watch and take over if the computer made a mistake. Oddly, the automation part might be more attainable than the human part, because it appears that the people who make the best controllers would be bored to distraction by such a passive role. Why, after all, should computers get the fun part of the job?

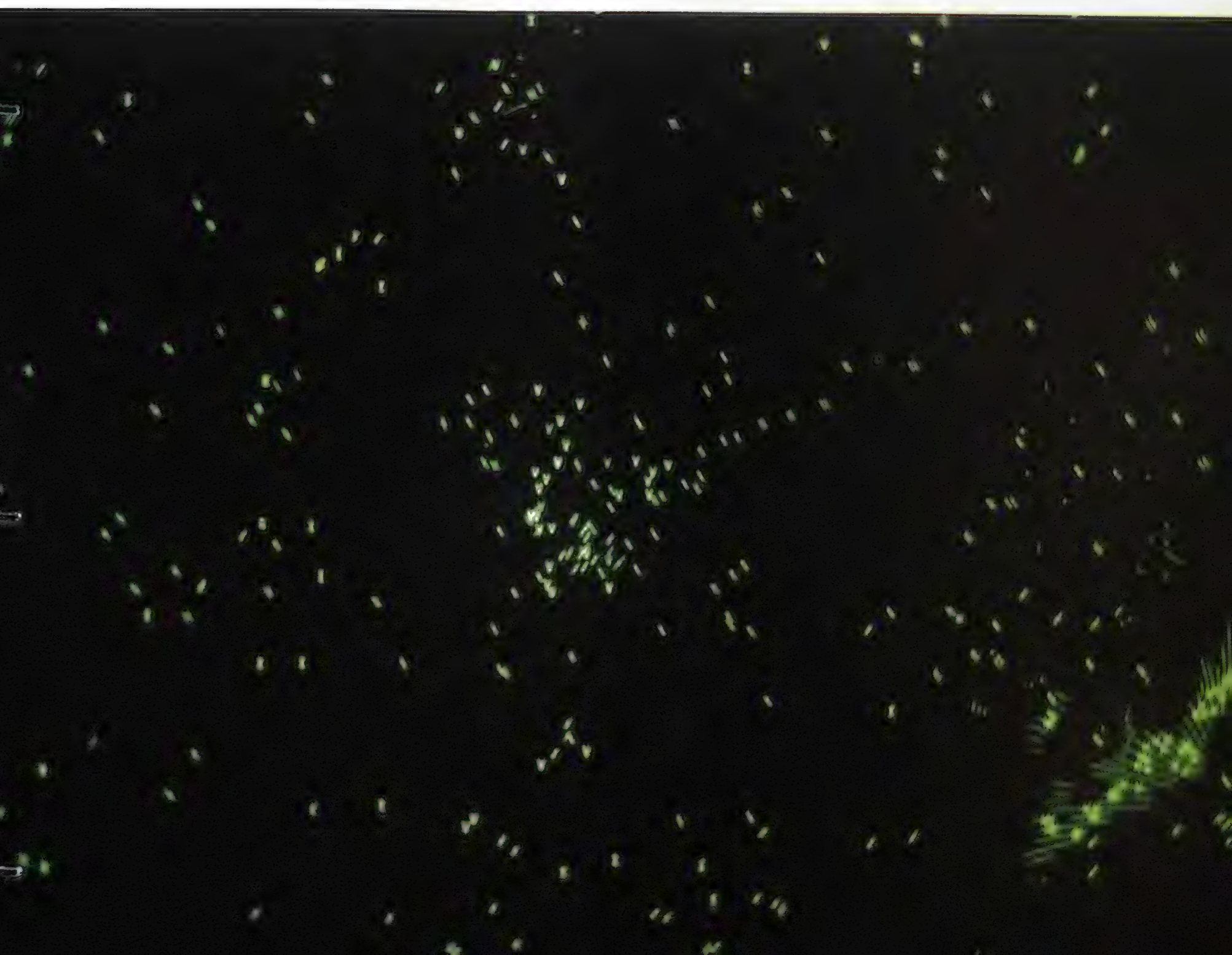
Gwen Sawyer, manager of screening and placement at the FAA Academy, recalls participating in a two-hour experiment in which she was expected to watch a radar screen and signal every time a simulated airplane left its assigned altitude and did not return within a given time period. "Clearly few controllers today would want to be a part of that," she says.

The need for active involvement

"If you're not actively involved in controlling aircraft," says Dr. Richard Thackray, who supervises stress behavior research at the FAA's Civil Aeromedical Institute, "there's a real risk of losing the picture and not being able to intervene effectively when you're needed." This human factor raises the possibility that a backup computer, rather than a person, would have to come forward in an emergency.

The academy and its screening program won't be closing down any time soon, though. Its doors opened to 3,000 would-be controllers last year, up from 2,000 the year before, and the academy would like to speed the process even more by somehow boiling down the screening program into a few days of superbly calculated testing. But so far, nothing seems to identify controllers so well as its eight-week pressure cooker. "I've never worked so hard to do so poorly," says Jeffrey Rohner, a recent graduate. "But I had the feeling that if I could overcome this, I could do almost anything."

Tony Brescia, a 1970 graduate of FAA Academy, is an area manager at Fort Worth en route center—a destination for some new FAA trainees. Below is a radar image of part of the airspace for which this center is responsible. Each green blip is an aircraft; in middle is Dallas/Fort Worth airport. The time is 11 A.M.—morning rush hour; each air traffic controller handles about 15 planes.



Giant goannas menace a black wallaby, at center, as two short-faced kangaroos, at left, watch closely.

By Andy Park

Giants once ruled Australia, fossil discoveries reveal

Working a site long avoided for its physical difficulties, paleontologists have hit a jackpot of oversize birds, mammals, reptiles

In the misty dawn, a black wallaby emerges from the undergrowth bordering a river. As she moves cautiously down the bank, brightly colored parrots high in the paperbark trees begin their strident welcome to the sun. Several other wallabies and short-faced kangaroos are already at the water; they pause in their drinking to watch the newcomer. Other eyes also watch. A young giant goanna (a lizard "only" nine feet long) charges from its hiding place. Animals scatter as the reptile lunges at the little wallaby. She dodges, and gleaming teeth rip only air. Not so lucky is a short-faced kangaroo, which bolts blindly into the jaws of a full-grown giant goanna, all 21 feet and 1,300 pounds of it.

Prehistoric Australia, like other continents, was populated by giants—animals larger than all but the largest of those on Earth today. North Americans have known about indigenous saber-toothed tigers and woolly mammoths for more than a century. Australian scientists are only now discovering the great variety and abundance of that continent's megafauna. The differ-

Photographs by David Robert Austen
Illustrations by Peter Schouten

ence is geology: compared with other continents, Australia is flat with a stable crust. Erosion does not reveal the paleontological riches it does elsewhere.

Occasionally, however, rich surface deposits are discovered. Just over a decade ago, on a cattle station—Americans would call it a ranch—in western Queensland, a stunning array of limestone-encrusted fossils began to shed new light on the past. Riversleigh Station, the setting for the opening melodrama, is average-sized by Australian standards: 1,200 square miles of rugged country covered with needle-sharp spinifex grass and eucalyptus and acacia trees on which up to 8,000 cattle graze.

Fossil-bearing rocks were discovered near the station homestead in 1901, but they were ignored for more than half a century. Early in 1963 Richard Tedford, a paleontologist from the American Museum of Natural History in New York City, and Alan Lloyd, an Australian geologist, visited Riversleigh and collected the fossilized bones of three new mammal species. The fossils were difficult to extract, however, and the site far removed from the sediments of central Australia where scientific attention was then focused. The Riversleigh fossil beds were largely abandoned for still another decade.

In 1976 there arrived Michael Archer, a paleontologist and now an associate professor of zoology at the University of New South Wales. Archer had heard of the fantastic but "immovable" fossils while visiting a colleague. Warned of the limestone's hardness, he brought electric jackhammers. They worked, but when he came back two years later his group resorted to light explosives to crack the boulders. During that expedi-

Andy Park, an Australian freelance writer and photographer who specializes in natural history, wrote about the Tasmanian tiger in August 1985.

Helicopter lands in spinifex grass to pick up bags of fossil-bearing limestone from the Riversleigh sites.

Forty tons have been carried out so far, eventually to be trucked to the University of New South Wales.

Volunteer Margaret Beavis helps Michael Archer bag rock samples loaded with the skulls of vertebrates.

Henk Godthelp gets help from volunteers as he splits boulder of fossil-rich limestone into portable pieces.

tion, one of Archer's colleagues, Henk Godthelp, discovered Microsite, an area that yielded thousands of complete bat jaws. The only previous fossil evidence of bats in Australia had been from two teeth found at separate locations, and these gave few clues to what their owners had been like. That year the group collected nearly five metric tons of bat-rich limestone and backpacked it out of the rocky terrain to where it could be reached by motorized vehicles.

Archer and Godthelp were soon joined by Sue Hand, a bat specialist, and the three spent several years recovering bat jaws from the Microsite limestones. They finally returned to Riversleigh in June of 1983, hoping for a summer as fruitful as the one five years earlier.

Finding a new mammal every two minutes

One night, while sitting around the campfire, a member of their group handed Archer a bone he had found that day but couldn't immediately identify. Archer quickly passed the small piece to Hand, who promptly dropped her teacup. The fragment belonged to a bat unlike any of the Microsite finds. First thing the next morning, the group headed to the spot. Within an hour, they found the remains of 30 new mammals—not only bats, but large marsupials as well. It had taken paleontologists more than 150 years to discover the 70 pre-Pleistocene mammal species known before the group discovered Gag Site. In a matter of minutes that number was increased by more than 40 percent.

"But we knew we needed help," Archer says, "and lots of it. Most of the rock in this region is dark gray, 530-million-year-old limestone formed when inland seas covered Australia. But aerial photographs showed 15 square miles of light gray limestone among the dark. This light rock is the only evidence left of freshwater pools and lakes that dotted the area about 20 million years ago, long after the seas disappeared. We had collected all our new species from only three of these light-colored deposits—the potential was electrifying!"

Volunteers joined the team, and the jagged outcrops soon echoed with the thunder of explosives, rock drills and sledgehammers. So far the group has found more than 100 deposits from three distinct epochs. Since 1983, they have discovered in excess of 100 new mammals. The numbers of new reptile, amphibian and bird species found have similarly skyrocketed. In addition to the light gray Oligo-Miocene limestones on a plateau high above the Gregory River, closer to the river there is a Pliocene cave floor called Rackham's Roost, three million to five million years old, and next to the Gregory, a Pleistocene deposit called Terrace Site that is possibly as young as 50,000 years.

"Twenty million years ago the plateau was dense rain forest," Archer explained, "and those pools and

A prehistoric python makes a meal of a wallaby that it has killed by crushing. This species grew up to 16 feet long, a size attained by some of the boas and pythons now living. While most large snakes live in the tropics, this one managed to thrive in a temperate climate.

Aboriginal legends about giant birds have turned out to be true. Fossils from a site near Alice Springs have revealed a species that stood more than nine feet tall and weighed 1,100 pounds or more, rivaling the extinct elephant bird that lived in Madagascar.

lakes harbored six-foot lungfish, large primitive platypuses with well-formed teeth, massive turtles and three species of freshwater crocodiles. Cow-size marsupials and a dozen kinds of kangaroos browsed in the understory. Overhead in the canopy, scores of different species of possums clambered about in search of food while parrots, cockatoos and Australia's earliest known songbirds flitted through the branches.

"Predators were there: 25-foot pythons, a leopard-size marsupial lion, at least two different kinds of thylacines [smaller ancestors of the recently extinct Tasmanian tiger, SMITHSONIAN, August 1985] and carnivorous kangaroos that looked innocent but sported lancelike lower front teeth."

Today teams are digging all over the plateau. At Gag Site they found the jaw of a small marsupial with teeth so bizarre that they temporarily named it *Thingodonta.* A partial skull and more jaws turned up, confirming that it was unlike any marsupial known. Now known as *Yalkaparidon,* it is the founding member of an order all its own.

Bitesantennary, punned from Australia's 200th birthday, appears to be the floor of an ancient cave where great colonies of bats once lived. "The site is

The largest marsupial that ever lived was also the first fossil mammal to be discovered in Australia, back in 1838. But no one is yet sure what the head looked like; the animal may have had a trunklike snout. It is known only as *Diprotodon optatum.*

One of the most unusual of Australia's early fauna was this marsupial lion. Paleontologists believe that it preyed on kangaroos on the ground, dragging its victims up into the trees, as leopards do today; it had grasping hands as well as possumlike feet.

surrounded by limestone without fossils, and you can see the edges quite distinctly—we're convinced that it's the floor of an ancient cave," says Sue Hand. "When I started examining the material coming out, I realized that this site contains some of the best-preserved bat fossils in the world. Over the next few years I'll place these Riversleigh bats into evolutionary lineages with other fossil bats from Europe, Asia, Africa and Melanesia. Eventually I'll have an overview that will tell us when the Riversleigh bunch split from their overseas relatives, and more precisely when they actually arrived in Australia."

Bats have lived in Australia for at least 25 million years. Hand is already finding that most of the fossil species are not those of Gondwana, the ancient supercontinent from which Australia split 45 million years ago, but rather species that emigrated from Asia, with which Australia collided 15 million years ago. They are mostly leaf-nosed bats, known to be poor fliers, so their early colonization of Australia adds weight to a new theory that an ancient island chain connected Australia with the Asian mainland. Until recently, most scientists believed Australia had been isolated by thousands of miles of open water.

Sue Hand measures jaw of young crocodile for a study of environmental changes over 25 million years.

The Pliocene (the period when Australia's climate rapidly became arid, a tumultuous time for the indigenous fauna and flora) was missing from the Riversleigh digs until Rackham's Roost was discovered in 1984. Perched on cliffs overlooking the Gregory River, this site is also an ancient cave floor. Bat fossils are common here, too, but some of these are large carnivorous bats whose modern-day descendant, the eerie-looking ghost bat, still inhabits the region. Also present are fossils of the bats' prey, smaller bats and murids (rats and mice). These ancient rodents are of great interest to Henk Godthelp, a murid specialist.

"Rodents are by far the largest and most diverse order of mammals in the world," Godthelp says with just a hint of pride. "It's not surprising, then, that they would invade Australia. What is surprising is that only one group, the murids, actually made it."

The evidence from Rackham's Roost shows that 10 or 12 species of murids were established in Australia 3 million to 5 million years ago. The earliest known murid, from Pakistan, is only about 15 million years old; it would appear that the rats and mice spread quickly, paleontologically speaking, throughout Asia and then island-hopped to Australia. This is not surprising for what Godthelp calls the "most adaptive and ecologically successful group of mammals in the world."

Most interesting of all the Riversleigh fossils are the Pleistocene megafauna that presumably shared the continent with the early aboriginals. There were 14 species of short-faced kangaroos, including *Procoptodon goliah*, eight feet tall and weighing more than 650 pounds. Huge flightless birds, much taller and much heavier than the modern emu, roamed the plains. Sporting deep, heavily reinforced bills and massive legs, *Genyornis* was the last survivor of a diverse group of giant birds known as the mihirungs. One of its ancestors was *Dromornis stirtoni*, more than ten feet tall and weighing up to 1,100 pounds—a rival in magnitude to the extinct elephant bird of Madagascar.

Most of the big carnivores were not mammals

Ponderous four-footed marsupials grazed the Pleistocene plains. These were the diprotodontids; members of this family ranged from the size of sheep to that of the largest of marsupials, the hippopotamus-size *Diprotodon optatum*. Large carnivorous marsupials were uncommon, however; the largest unearthed so far is the lion-size *Thylacoleo carnifex*. It lacked big canine teeth but had enlarged upper and lower incisors instead. Its digits were clawed, but each forepaw had a semiopposable thumb ending in a talon.

The most-numerous large Pleistocene carnivores were reptiles. The giant goanna we mentioned earlier was the largest terrestrial predator, similar in its habits to its smaller, living relative, the komodo dragon. Big enough to have killed any marsupial, the giant goanna was equally adept at eating carrion. Other large predators were also reptilian: giant snakes, and freshwater crocodiles as big as the saltwater ones living today.

The most important predators of the late Pleistocene however, were mammalian—hairless bipeds smaller but smarter than the megafauna they preyed upon. The aboriginals arrived in waves, judging by the sudden appearance of specialized tools and weapons in successive deposits. At least some scientists maintain that the arrival of human beings not only coincided with the demise of the megafauna but in fact caused it—just as some scientists in the United States have argued that the Indians were responsible for the

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disappearance of many large animals in the Americas.

"Only the largest herbivores and carnivores disappeared in Australia," says Tim Flannery, curator of mammals at the Australian Museum in Sydney, "and this was typical for any region where Man suddenly appeared as a fully evolved modern hunter."

What about the popular notion of the pre-European aboriginals being the embodiment of the "noble savage"? "Just look at the devastation Europeans caused when they first arrived in Australia," Flannery explains. "Why should we expect aborigines to be any better when they arrived here 40,000 years ago? Look around the world. Extinctions don't correlate well with ice ages or anything else climatic. But there's a definite correlation between the arrival of human beings and the extinction of megafauna: Madagascar and New Zealand 1,000 years ago; North America about 11,000 years ago; Australia about 40,000 years ago. The results were devastating. In Australia every native land mammal over about 150 pounds disappeared; the largest one left is the red kangaroo."

Among those who are not so sure is David Horton, a paleoecologist at the Institute for Aboriginal Studies in Canberra. "I have grave doubts about continental extinctions caused by Man. Sure, on islands like New Zealand or Madagascar it's certainly possible, but not on continents. Severe climate is a much more likely culprit in Australia."

Horton agrees that megafaunal extinction was linked to the great size of the animals, but not because size made them easy prey for human hunters. "Being large meant they needed a lot of food and water," he maintains, "and during droughts they were tied to a series of water holes—they could range only a certain distance searching for food. In severe droughts they could be restricted to only one water hole, and once the vegetation surrounding it was consumed they'd certainly die of starvation."

Horton tells of a large fossil bed he studied in an ancient swamp near Lancefield in Victoria. The bones, under six feet of clay, dated to about 25,000 years ago. The team dug a series of trenches and struck the deposit again and again, a bed so rich that several hundred bones crowded each square yard.

"They were all jumbled up like pick-up-sticks," Horton says, "and we estimated the deposit represented 10,000 giant kangaroos. The only evidence of humans we found was one hand-ax flake, nothing else—no burned bones, no butchering marks, nothing. Now, if humans were involved in this, you must imagine a group of aborigines slaughtering thousands of kangaroos and eating maybe the tips of their tongues and then carefully picking up every trace of the tribe's presence. It's just not on. But picture a severe drought: this prehistoric spring would become a deadly trap surrounded by countless hectares of parched, barren earth. Thousands of giant kangaroos would starve at its edge. Smaller animals would have escaped because they don't have a daily need for water and some can even absorb sufficient water from their fodder. Under

The Gregory River flows through Riversleigh Station, providing greenery in an otherwise arid landscape. It also cuts into the sedimentary rock, uncovering fossils as it meanders along its course. Outcrops on the plateau in background contain fossils at least 20 million years old.

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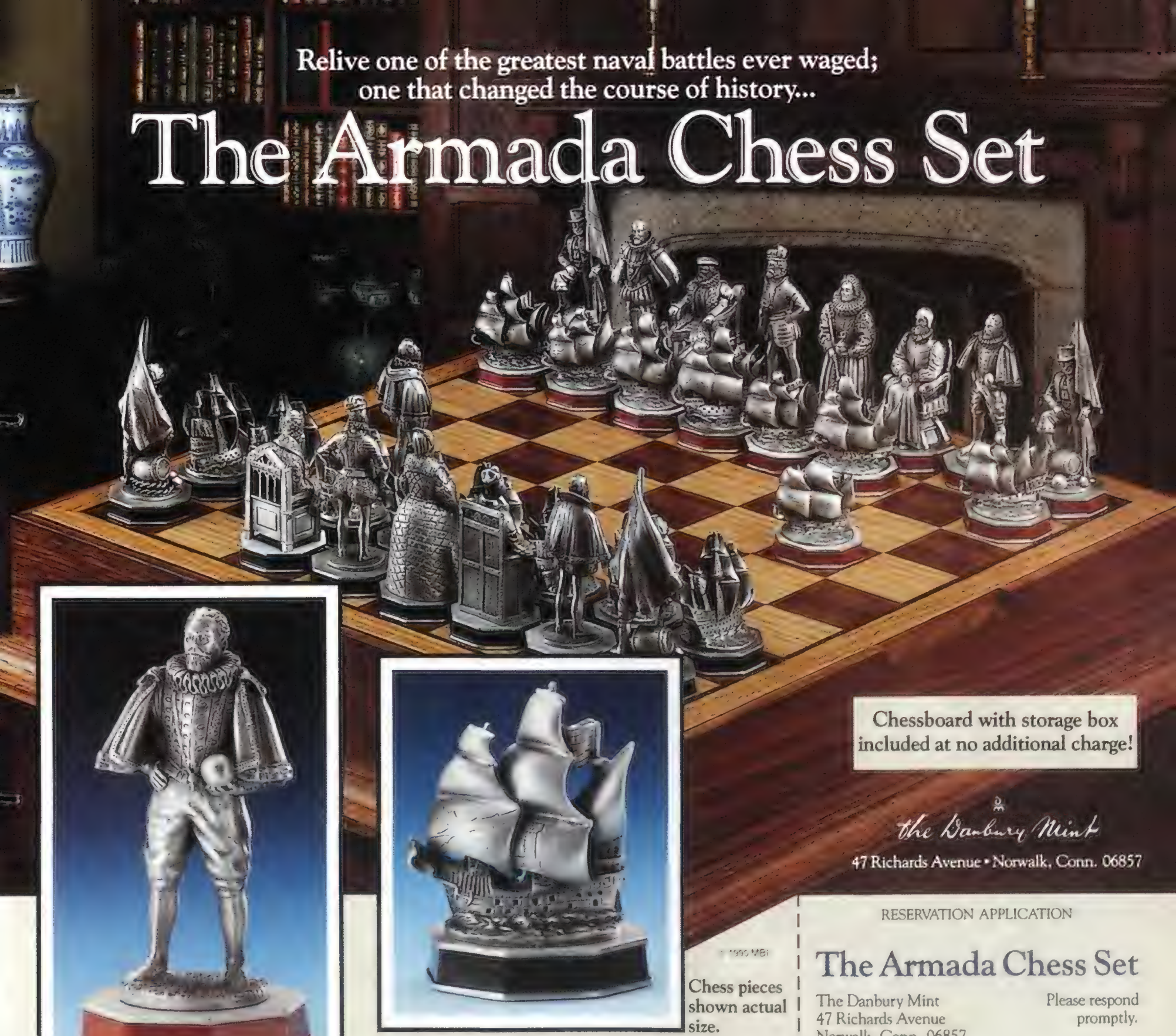

Sir Francis Drake: *English Knight*

The Florencia: *Spanish Pawn*

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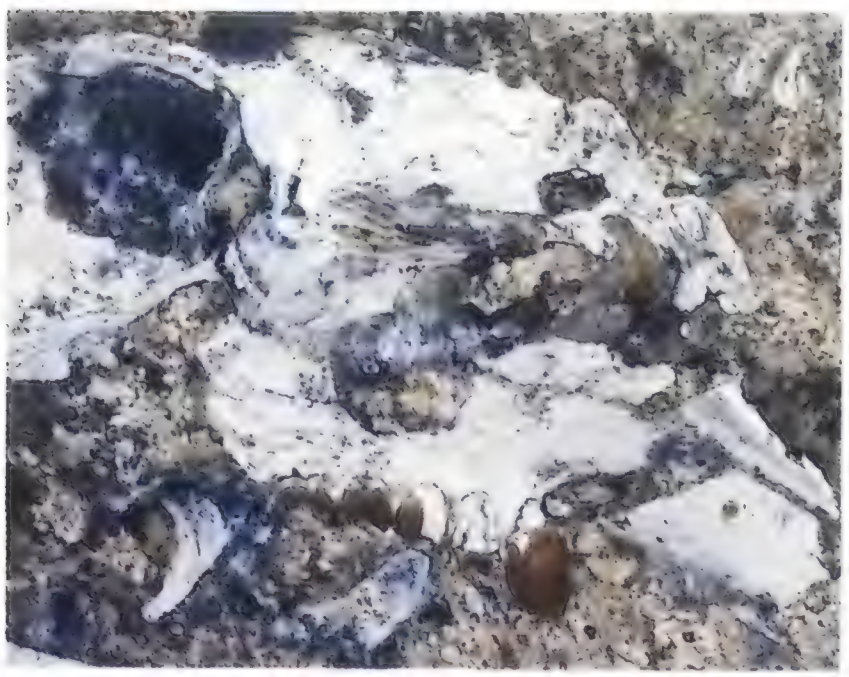
Naturally acid rainwater etches limestone, revealing fossils such as this skull of a sheep-size marsupial.

A fossil potpourri includes crocodile ribs, a bone from a giant bird and partial remains of a turtle.



One of the best finds was this skull of a carnivorous kangaroo; snout protrudes right, teeth are at bottom.

these extreme conditions, there's a physiological cut-off point that limits size—and this spelled the end for megafauna."

Horton adds that early aboriginals probably did kill and eat the giant animals, but would have had little effect, in his opinion, on healthy populations. Moreover, the ancient aboriginal practice of burning off an area to flush out the animals and stimulate vegetative growth would have hurt smaller animals more than larger ones. Burning reduces thick forests and encourages grasses and herbs, providing ideal habitat for grazing megafauna.

The truth may lie somewhere between. Fossils at still another site seem to show that at least some of the megafauna and the aboriginals may have coexisted until 6,000 years ago. Tooth fragments of diprotodontids were discovered in an area known as the Liverpool Plains, about a five-hour drive northwest of Sydney. Leader of the dig there is Richard Wright, professor of anthropology at the University of Sydney: "Certainly our evidence says that diprotodontids at the Liverpool Plains survived the last ice age and lived well into the Holocene—up to about 6,000 years ago. But this doesn't contradict any other research, it simply brings diprotodontid survival forward from the 30,000-year-old finds at Lake Mungo in central Australia."

A drying out—and then the dust storms

Wright compares the situation to that in Africa at the same time. "We know that giraffe and rhinoceros were living in the Sahara toward the end of the last ice age, but they became extinct when the region dried up. They continued to flourish down south in the Serengeti, however. I believe a similar situation occurred in Australia—the center dried out and the diprotodontids survived only in more favorable environments like the Liverpool Plains."

What finally did the great animals in, Wright believes, were dust storms. "We've uncovered massive accumulations of calcium carbonate dust at 26,000 years ago and again at 6,000 years ago," he says. "This material is consistent with dust from the Lake Eyre basin in central Australia. Geologists have demonstrated that hundreds of cubic kilometers of sediments are missing from the basin. I believe they were blown, as dust, from the dried bed of the lake during the Pleistocene. The dust was carried east by the annual northwesterly winds and was trapped by the swamp vegetation in western New South Wales. This stuff would have been rich in common salt, which severely damaged the annual herbs and grasses around our swamps before it was dissolved out by rain. All that's left today is the relatively insoluble calcium carbonate fraction. We have diprotodontids before and after the

26,000-year-old deposits, but after the six-foot-thick deposit at 6,000 years the swamp ceased to exist and we've found no trace of diprotodontids."

Wright does not believe the salt storms by themselves wiped out the huge grazers, however. The storms probably did reduce their populations, he says, but it is the appearance of two new factors in the archaeological record about this time that may have sealed the fate of the last surviving megafauna.

The first is the appearance of the camp-following, hunter-scavenger dog, the dingo, and the second is a sudden improvement in aboriginal hunting technology, a spear with stone barbs fixed to the shaft. Dingos are very efficient predators, according to Wright, especially on young marsupials, and the barbed spear is much more lethal than the old sharpened wooden shaft. "The combination of these may have been enough to push diprotodontids into extinction."

Thus the picture that emerges is of populations of spectacular beasts squeezed into smaller and smaller ranges by climate and hunted down by increasingly efficient predators. One can't help thinking of today's Africa, where Pleistocene animals are rapidly losing their habitat, all the while being hunted down by poachers. Megafaunal extinction is happening again, one more time.

A limb bone, probably of marsupial herbivore, is exposed to light for the first time in 15 million years. The aridity of the area stands in sharp contrast to the lush rain forest there when the animal was alive.

Group of "Immortals," after 1985 session of word testing, includes Dominican Father Ambroise Carré; standing to his left in same row is author Maurice Druon and, next to him, former prime minister Edgar Faure. Poet and ex-president of Senegal, Léopold Sédar Senghor, is third from right in the photograph.

By Joseph Harriss

Qu'est-ce que c'est? A social club or a cultural bastion?

After 355 years, the Académie Française and its 40 'Immortals' are still trying to keep the French language pure in heart

It happens, on average, twice a year. At 3 P.M. sharp, a group of oddly accoutered elderly figures head down the narrow, steep staircase of a handsome, domed building that faces the Louvre across the Seine. Often steadying themselves on the banister, they wear stiff, dark, swallowtail suits embroidered with green olive leaves and carry ostrich-plumed cocked hats under their arms. They concentrate hard on not tripping over the ornate épées that brush against their calves.

When the frail little company reaches a vaulted baroque hallway where a stone Cardinal Mazarin kneels on his own red-marble casket, the silence is suddenly broken by a barked command: "*Présentez . . . armes!*" A 20-man detachment of France's ceremonial Garde Républicaine in kepis and white gloves hoist sabers to their chins as a loud drumroll—like the one that used to announce the fall of the guillotine blade—crepitates through the vaults.

As the members take their places, 300 invited guests stand respectfully in the rotunda beneath the dome. One remains standing at the third seat in the next-to-last row, nervously fingering a thick manuscript. For

the next hour, this successful candidate delivers a stream of fine, euphonious phrases and carefully turned past-perfect subjunctives in eulogy of a deceased, and largely forgotten, predecessor, then listens to a donnish reply describing his or her own life and work. Abruptly, the stylized liturgy is over. Members and guests file back into the vaulted hall, where there is much congratulating and kissing on both cheeks.

In much the same form, this ritual induction of a new member into France's cultural paradise, the Académie Française, has been going on for more than 350 years, come king, revolution, emperor or republic. "The Academy is the great witness of French civilization," says the daily *Le Figaro*. "What happens beneath that dome links us to all our historical and cultural tradition."

A most idiosyncratic institution

It's a tradition that pays its respects to culture heroes the way other countries revere businessmen or Stakhanovites. Paris is still the only city that I know of where until fairly recently you could list your profession in the phone book as *Homme de Lettres*. Where else do they present arms to men of letters? Or at dinner parties place them higher than government ministers and just after cardinals and princes of the royal blood? Since Plato's "Academy," which met in an olive grove, where Milton's "Attic bird Trills her thick-warbled notes the summer long," many countries have had academies, including our own American Academy of Arts and Sciences. But France's, rooted in the Gallic nation's quirky idea of itself, is the most idiosyncratic and durable. In 1908 Lord Asquith, the British prime minister, was convinced that there were only three eternal things in the world: the German General Staff, the House of Lords and the Académie Française.

Of the three, the Academy is also the hardest to define. Apart from tinkering interminably with a dictionary to keep the French language pure, it serves no visible purpose. Yet it seems to fulfill a French need for grandeur. Its coveted, theatrical uniform has long symbolized the crowning achievement of a distinguished career for the country's writers, academics, scientists, jurists and other Establishment figures. Its 40 members constitute the officially recognized *fine fleur* of French civilization, though the French themselves are hard put to say why. As Maurice Druon, the Academy's courtly Perpetual Secretary, explains, "the Academy is a complete paradox." It has a "moral authority, though no one can say exactly what we exercise it over, except vocabulary. This authority is evident, but nobody quite knows its source." No wonder the French, ever aware of the necessity of the superfluous, hold the Academy in such high esteem.

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Cultural whiz Jean Cocteau leaves the Academy after his 1955 induction.

Whatever it is they do, or stand for, members of the Academy have had their work cut out for them since Cardinal Richelieu granted the Academy its letters patent in 1635: "To work with all possible care and diligence to give strict rules to our language and to make it pure, eloquent, and capable of dealing with the arts and sciences." The canny cardinal, chief minister to Louis XIII, had his own reasons for offering the state's protection to the small group of Parisian writers who met informally for good conversation. Literature should be under government supervision like everything else in the strongly centralized French state: within an official academy the talk was less likely to get too political—or subversive. He stipulated that the new institution should compose a dictionary, along with works on grammar, rhetoric and poetics.

After the group spent a few years of precarious existence without any fixed meeting place, Louis XIV set it up in

The author has lived and worked in Paris for most of the past 25 years.

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the former Louvre apartment of the queen mother and donated 660 volumes from his personal library, along with 40 goose quills. When one member, a cardinal, insisted that his rank entitled him to an armchair instead of the simple straight-backed seat of other Academicians, Louis sent around 40 comfortable armchairs—a surprising lesson in democracy from the king. Soon members were officially called Monsieur l'Académicien by the monarch, along with the church's Monsieur le Cardinal.

Came the revolution, and public opinion swung against the Academy for having been too close to the monarchy. Under the Terror, the Convention abolished the Academy in August 1793, calling it infected with "the incurable gangrene of aristocracy." Besides, as a member of the Convention put it, "The Republic doesn't need savants." Three members were guillotined on the Place de la Concorde, two committed suicide, three died in prison. France, wrote Madame de Stael from the safety of Switzerland, "has decimated its glory." But Napoleon, who knew that men are led by the prospect of honors, revived the Academy. He gave it Cardinal

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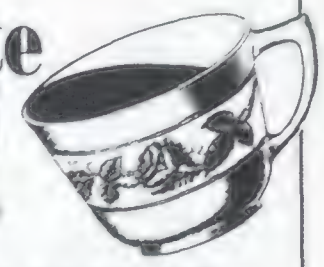

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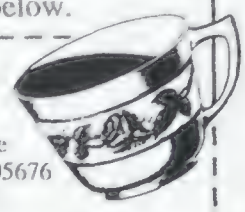

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In 1800s, full dress for Academicians included tricorn hat, knee breeches.

Mazarin's former palace and urged it to get on with the job of sprucing up the language.

Napoleon and subsequent French leaders recognized that in a land where words often seem as important as deeds, language is a national treasure to be cherished and defended—especially against the onslaughts of English. Recently, President François Mitterrand went so far as to create the French Language Commission specifically to find French equivalents of English terms—*mercatique* is the official, mostly ignored, replacement for "marketing," for example. As Mitterrand said in a recent speech to the Academy, "French today is threatened by English. . . . Can a country that can build the Ariane rocket afford to lose its language?"

Clearly *non*, and as a result of such efforts, commentators at last spring's French Open tennis tournament referred to a *manche* rather than a "set," and a *jeu décisif* instead of a "tie break." Nonetheless, French suffered a stunning setback last year when the journals of the Pasteur Institute, prestigious temple of French scientific research, were given English names, *Research in Microbiology, Research in Virology* and *Research in Immunology.* It helped not at all when a harried spokesman explained that most articles they receive are written in English, even those from French researchers. The French press roundly denounced Anglo-Saxon imperialism, calling English "a poor man's Esperanto" and muttering of "this monstrous and unworthy event, lowering our national prestige."

Such linguistic paranoia tends to obscure the fact that something serious is indeed at stake. "France is,

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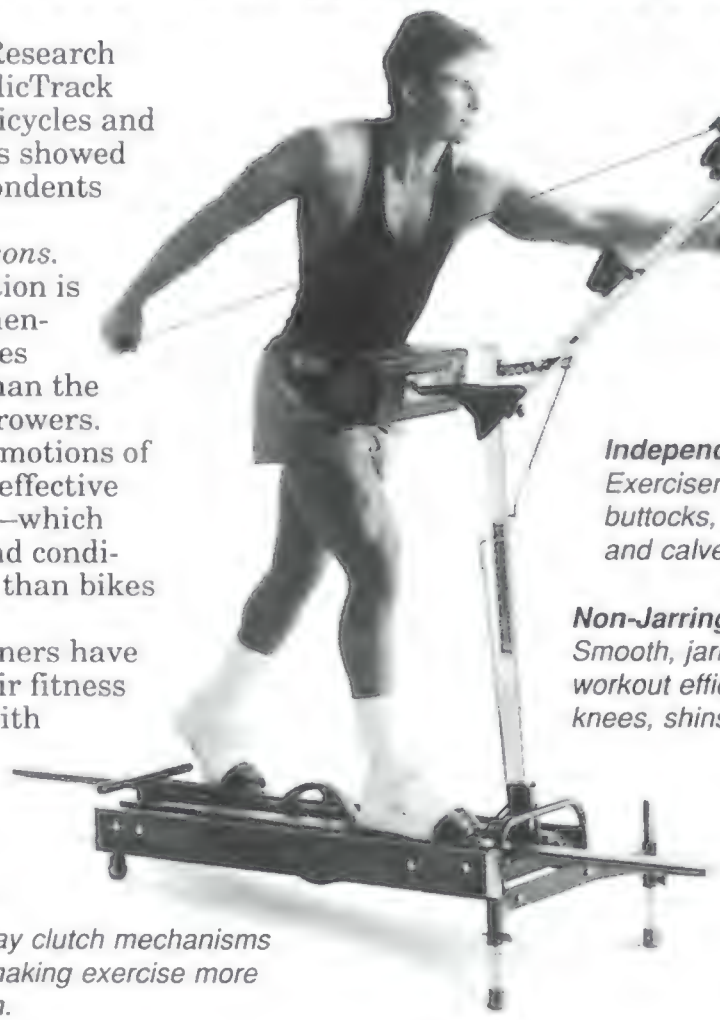

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above all, the French language," said historian Fernand Braudel, and if it's true that, to some extent we are what we eat, surely we are also what we speak. Today the French are pigging out on a junk diet of half-digested Anglicisms. Marginal theater productions, for instance, are labeled *un spectacle off*, a reference to Off Broadway. Someone good at his *job* is called *un pro*. A company that finances an individual or event does a *sponsorisation*. Movies have their *casting*, while new products show off fancy *packaging*. Yet the people charged with this work, the venerable members of the Academy, have always been the most lampooned of France's *monstres sacrés*. Writer Alphonse Daudet, who never made the club, satirized them as "decrepit, broken . . . with leaden feet, weak legs, eyes blinking like night animals." One writer, who did get elected in the early 19th century, observed dryly, "If fame, genius or creativity were required to enter here, the seats would often be vacant." A character in a popular play inquires about one of the members. "Between us, he's half-senile," comes the answer. "Oh, so he's getting better?" Playwright Eugene Ionesco, himself a member, has in one of his short plays an Academician who at 75 has only one regret: he never received his high school *baccalauréat*. He takes the exam and fails. But Flaubert, another in the long list of greats who were never elected, noted with wry accuracy the true attitude of most Frenchmen: "Always denigrate it—but try to be a member."

Try they do, some simply so they can add to their calling card, "Candidate to the Académie Française." And once infected with the desire,

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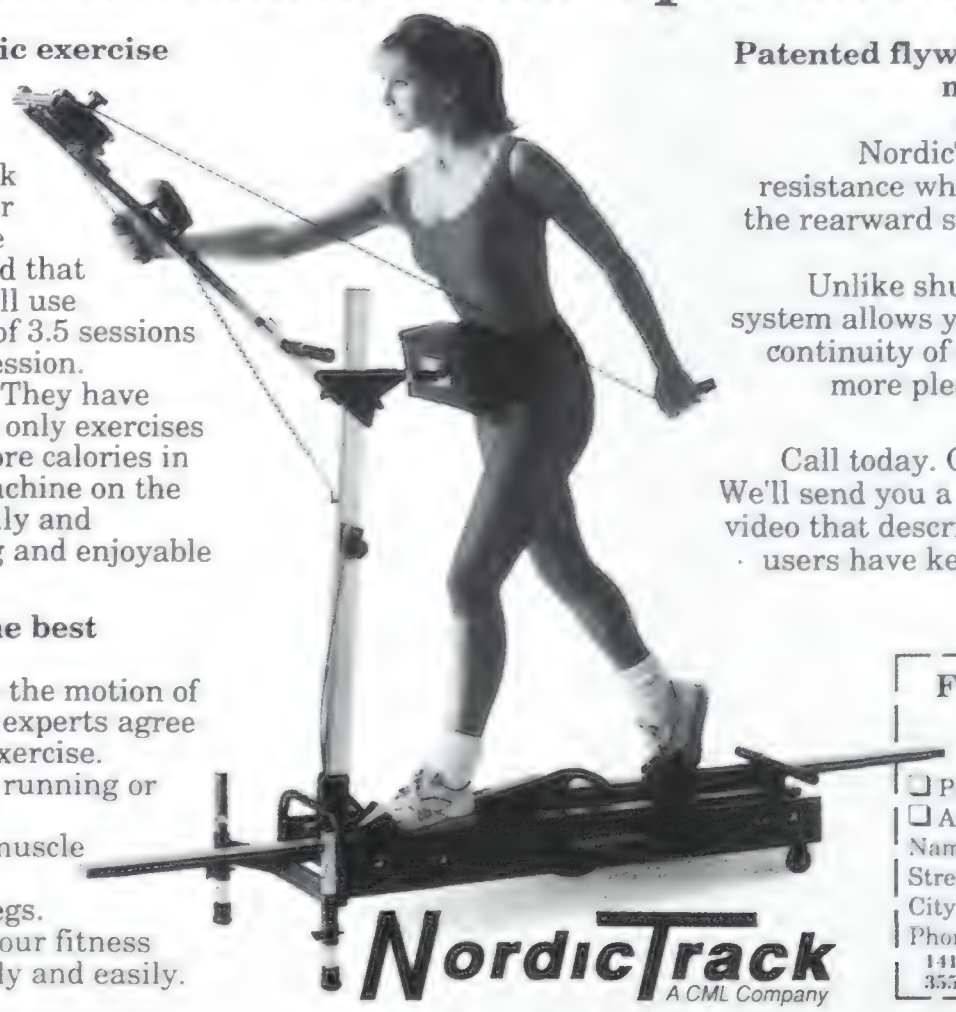

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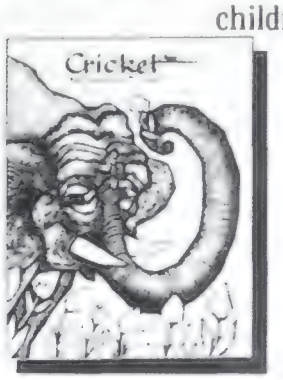

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some aspirants will do practically anything to get elected.

Voltaire, in bad with the king and the church, wanted in so much that he wrote verses cravenly praising Louis XV and even denied that he had ever written the freethinking *Lettres Philosophiques*. He was elected on his third try, in 1747, with a boost from Madame de Pompadour. Victor Hugo began campaigning for election in 1834, when he was 32, shamelessly buttering up the members. He was turned down four times before making it in 1841. It is said that François Mauriac, the morally rigorous Catholic author, hinted during his campaign that he had throat cancer and that he might not be long for this world. Elected in 1933, he lived another 37 years.

But few are chosen. Among the classics, Descartes was not elected because he went to live in Sweden. Pascal was "only" a mathematician. Molière refused to give up the ungentlemanly profession of the theater. The cynical La Rochefoucauld was in bad odor with the government, and let it be known that he didn't think much of the Academy.

In the 19th century, Emile Zola was an unsuccessful candidate 24 times; the timorous members disliked his literary realism and his courage in the Dreyfus Affair (SMITHSONIAN, August 1989). Balzac was refused, probably as much because he had financial troubles as for his rough literary treatment of the bourgeoisie, as was Alexandre Dumas *père*. Such poets as Baudelaire, Verlaine and Gérard de Nerval were too bohemian. The members encouraged André Gide to be a candidate in 1946, but he scared the old gents by saying he would publish a monograph justifying his homosexuality and put "*de l'Académie Française*" after his name to insure a good sale. He never got in. Then there was the candidate who owned a vineyard in Burgundy and sent each Academician a case of fine wine every year. He always got a few votes, but never enough of them to be elected—so members were sure of getting another case of Nuits-Saint-Georges the next year, too.

The most celebrated reject, Emile Zola, tried 24 times to gain admittance.

Who wants to be a member today? "Only about 55 million Frenchmen," said Jean Dutourd, puckish popular author of *The Taxis of the Marne* and *The Horrors of Love*, who has been a member since 1978. Drawing on his trademark pipe and wearing a sporty glen plaid suit, Dutourd ushered me to a sumptuous green leather Chesterfield couch in his Left Bank study a five-minute walk from the Academy. Author of 47 books and a regular newspaper column, the tall, 69-year-old Dutourd translated Hemingway's *Old Man and the Sea* and some Truman Capote when a young man. Mark Twain is one of his favorite writers.

"Except for a stubborn handful, I don't know anyone who is not, secretly

or otherwise, a candidate: women, children, oldsters, ecclesiastics, farmers, secretaries of Communist Party cells, street cleaners—everybody," he said with only a trace of irony. "Look," he added, warming to the subject, "there are only 40 spots for 55 million candidates. It's the triumph of snobbery. And snobbery is one of the most powerful motivations in the human soul, especially in France, the land of vanity." It was hard to fault his reasoning.

What are today's Academicians like? "They have the charming courtesy and sublime simplicity of those who have nothing more to expect from the world, having obtained the supreme and inalienable honor of being elected to the Academy," came the reply—along with a disarming grin. And what did it mean to him personally to be, as members are called, an "Immortal"? "It gives me great tranquillity. Even the newspapers are nicer to me now that I'm an official personage." A low laugh drained any pompousness from the remark and hung in the air like the Cheshire Cat's smile.

But are Academicians really superior to common mortals? After all, one present member, an antiquarian by trade, says he desired membership as compensation for the *baccalauréat* he never earned. Another is the author of an illustrated history of women's undergarments. Back in 1723, the Academy elected a candidate whose magnum opus was a history of cats (a prankster set loose a cat during his induction, and the public thereafter nicknamed him "Meeow"). As Ludovic Halévy, a minor 19th-century novelist, once said after becoming a member, "Some Academicians are talented, others aren't. The latter are especially worthy of respect because they made it without talent."

Jean Dutourd has his own view. "I once tallied up how many really superior men had been members out of the 650 or so since its founding. I was amazed to come up with 68. Better than 10 percent! No other group in the world has ever had as high a per-

In Daumier cartoon, Academicians curry favor by praising their fellows.

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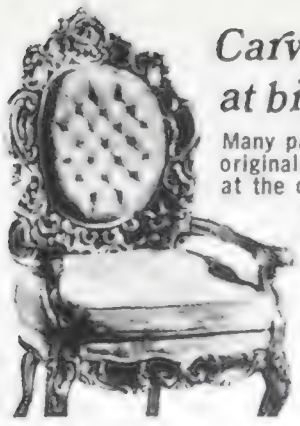

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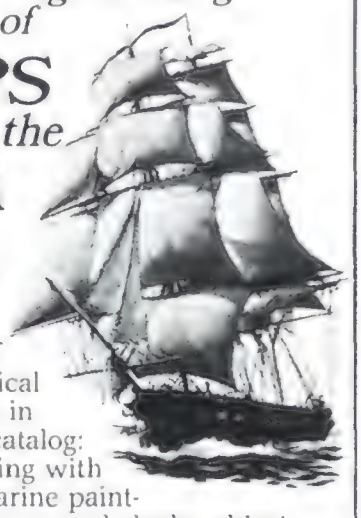

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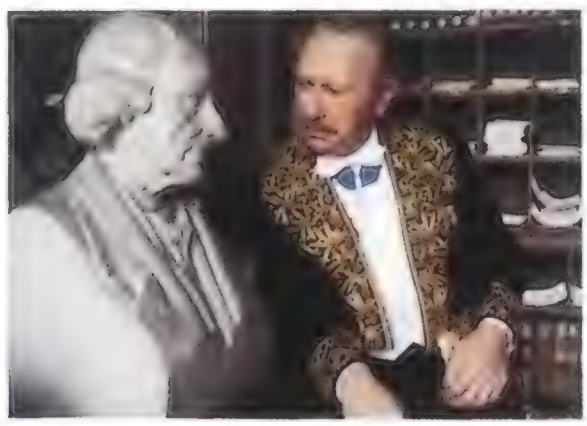
centage of geniuses, and none ever will." This time there is no grin; only a thoughtful draw on the pipe.

Lampooned or not, Academicians still have their fingers in the cultural dike. They are now producing with all deliberate speed the ninth edition of their dictionary of purest French. Having begun work on it in 1935, they have reached the letter "I," which is about par, since each edition has taken decades to produce. The first edition was presented with due pomp to Louis XIV on August 24, 1694, after some 60 years of scholarly labor. "I will read it at my leisure and will try to profit from it," the king gamely promised, although it classed words not in alphabetical order, but by roots, which made it virtually unusable. The current pace is even slower, but the 45,000-word oeuvre—with only about 10,000 new terms—is expected to be finished by the end of the century. For a rough comparison, the new Oxford English Dictionary, containing 616,500 words in 20 volumes, was completed in seven years.

About half the members turn up for the 3 o'clock Thursday afternoon dictionary sessions that last an hour or so, sitting at purple-baize-covered tables in straight-backed chairs, beneath the stern gaze of Richelieu's life-size portrait in cardinal's red robes by Philippe de Champaigne. Busts of past members line the walls, where four Aubusson tapestries hang. Tradition requires that Immortals remain exquisitely courteous, addressing each



Jean Dutourd, class of 1978, confronts a bust of the savant François Roulin.

Anthropologist Claude Lévi-Strauss (left) chats with colleague Jean Mistler.

other as "Monsieur" or "Madame," even if they have been friends since childhood, and using only the formally polite *vous*. Their conservative, purist approach to language was exemplified by the famous grammarian Emile Littré, a member whose reflexes remained true even when the flesh failed. When Madame Littré discovered him making love one afternoon to the household's *bonne*, she drew back and said, "I am surprised." Ever the man of letters, Littré, buttoning his clothing, replied, "No, madame, you are astonished. I am the one who is surprised."

Still, definitions have often proved elusive. In the first dictionary, the Academicians defined *amour* mainly as sexual passion, whereas now it is more elaborately seen as "deep affection that drives us to seek an intimate relationship with another being." *Femme*, brusquely defined in the 19th century as "the female, man's companion," has evolved into "a human being of the feminine sex." The aging Marshall Joffre, elected in 1918 after his victory on the Marne, often dozed during sessions; the day they defined "machine gun," he woke up long enough to explain, "It's a sort of gun that goes bang-bang-bang." New words have to be accepted by majority vote, as if they were laws. Among those recently approved: *basketteur* (*euse*), a basketball player, and *barmaid*.

"You must remember that in France, an individual is judged and classed by the care with which he expresses him-

self," said the ethnologist Claude Lévi-Strauss, an Academician since 1973, to whom I turned for a scientific view of the Academy's role in French society. Receiving me affably in his book-lined study in Paris' 16th arrondissement, he demonstrated Academy courtesy by rising twice to arrange curtains so I would not be bothered by the sun. According to one fellow member, Lévi-Strauss, author of landmark studies of the structures of primitive societies, once gave a mock-ethnological definition of the Academy—as a group of old men with feathers on their heads who camp beside the Seine.

"The dictionary is only the visible part of the Academy's function," he said. "But it has a symbolic role. As an honorary confraternity, it attests to the attachment the French nation has for its language. You can see that affection for their language in many other ways as well, for instance all the fuss they make here about changing the spelling of a word. You rarely see that in other countries. Take the United States. Americans readily abuse their language by adopting terms like 'thru traffic.' I don't think Americans respect their language. For them it's just an instrument that they adapt to their needs, and use with total liberty."

"Is that bad?" I asked.

"Not necessarily. That's what gives savor to American English. There are new words all the time, an incredible creation of new words and expressions. But it's a completely different attitude from ours."

"Still," I pointed out, "the French seem in love with English words, even to the point of inventing them."

"True, the French are always inventing English words, like *tennisman* for "tennis player" and *footing* for "jogging." That's one of the main things

Smoker (and reject) Théophile Gautier was cartooned as tobacco container.

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we try to prevent when we reject new words. But," he sighed, "language always evolves too fast."

When not applying the brakes to France's skidding language, the Academy is busy awarding prizes: more than 300, worth a total of some $230,000 annually, for literature and various prizes for "virtue," not always given. Among the *prix de vertu*, one is for domestics who show devotion to their masters, another for young women who house and support their parents after a reversal of fortune, and even one for "the daughter of an army officer who is without resources and unable to obtain from the government the franchise for a tobacco shop."

Statistics show that an Academician lasts about 20 years, and the Academy averages about two deaths per year. After a suitable period of mourning, members get down to their other main occupation, election of a replacement. This they enjoy hugely, as Paul Claudel once cynically remarked: "Elections are such fun. Why don't we have them more often?"

The main requirement to be a candidate is a certain *je ne sais quoi*, the only others being French nationality and the ability to write a letter declar-

Paul Claudel, poet, dramatist and diplomat, was elected a member in 1946.

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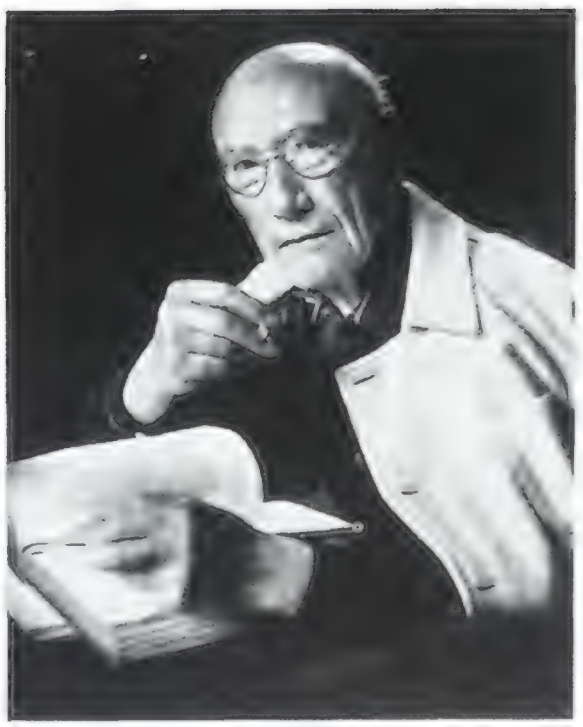
ing candidacy. (One current anomaly is writer Julian Green, the only American ever admitted. Elected in 1971, he was born in Paris of American parents, attended the University of Virginia, and wrote his first novel in English, though 59 other works are in French.) No diplomas or degrees are necessary, nor is there any age limit—a 17th-century marquis was elected at 16 with some royal help; Cyrano de Bergerac's creator, Edmond Rostand, the youngest in this century, at 33; and the oldest, historian Fernand Braudel, at 82. François Guizot, a 19th-century historian and statesman, described the ideal candidate: "He's presentable, polite, has received certain honors already, has no opinions of his own. Oh I know, he has written a few things, but nobody's perfect."

Still, if there is nothing dishonorable about being a member of the Academy, as the French say, it is humiliating to be a candidate. You have to write to each member requesting permission to visit him. To be proper form, the letter must be handwritten. Many who would be shoo-ins, like the late André Malraux, decide not to try at all because they find the very idea of the visits humiliating. As Jean Dutourd describes a typical visit, "He asks your age, and whatever you answer, he replies, 'But you're only a kid.' You who are a patriarch, a doyen everywhere else, you're only a kid in the Academician's eyes. Worst of all, a kid who only speaks when spoken to, who says 'Yes Master,' 'No Master,' 'As you like, Master.' "

The late Edgar Faure, for decades one of France's consummate politicians, said his candidacy for the Academy was the toughest election he had ever won. "I've never been so nervous as when those old sphinxes had such power over me." Claude Lévi-Strauss didn't like the visits because he was so edgy that he was always a half-hour early and had to wait in the street. "But I understand why they're necessary," he says. "The Academy is like a club; members want to know if you're an *homme de bonne compagnie.*"



Novelist André Gide did not want, and was not wanted by, the Academy.

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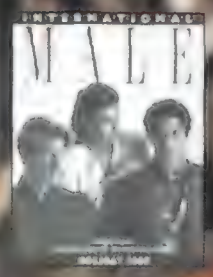

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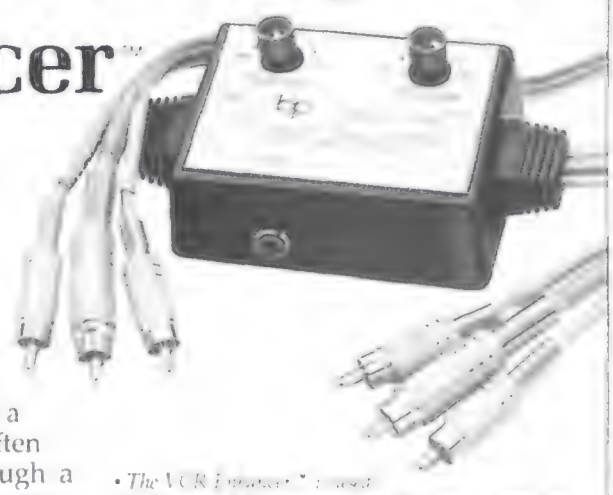

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Twice in recent years, the *homme* has been a *femme*. The late Marguerite Yourcenar, author of *Memoirs of Hadrian*, was elected in 1980 after President Giscard d'Estaing let it be known that the Academy ought to open its doors to women. The second woman, Jacqueline de Romilly, a self-effacing specialist in classical Greek literature, was installed last fall.

The election won, the new member pays a courtesy call on the president at the Elysée Palace. Usually this is a simple formality, although Léopold Sédar Senghor, a former president of Senegal and the self-styled poet of *negritude*, demanded to be received like a king, reflecting his African tribal status, so the Elysée rolled out a red carpet. The next, eagerly anticipated, task is to order the Academy uniform and ceremonial épée.

The elaborate uniform, designed at Napoleon's command, takes up to six months to make and costs about $16,000, but that includes a cocked hat. (An épée can be had for as little as $13,000, usually paid by the candidate's friends.) Virtually the only

makers today are Lanvin and Cardin, and a bespoke tailor by the name of Henri Nitlich, who crafts each suit out of—oh irony!—strong and supple English cloth.

"I do three fittings, and then take the whole thing apart and lay it flat to be embroidered with the olive leaves," Nitlich says. Academicians, he adds, "express their personalities in the color of the embroidery. Some want it more golden, but I like light green. Each leaf has a bit of cardboard inside with silk thread embroidered over it, though some want 18-carat gold thread. You should see their eyes light up the first time they put the suit on with the embroidery on it. They suddenly realize that they're really members of the Academy. Their faces change completely."

The épée, which is worn on the left side attached to the trousers, is a nuisance for everyone, starting with the tailor. Nitlich insures that the waistband is solid enough to stand the sword's weight, and uses nonelastic, English—more irony—suspenders for security. The épée gets in the way when entering a car or descending stairs. But it is a work of art laden with symbols from the wearer's life and work.

The most famous was that of the late Jean Cocteau, which today is insured for $50,000. At first, he wanted his friend Pablo Picasso to design it, but the incorrigible prankster responded with a sketch for a "breakfast sword" with a hilt shaped like a coffee cup and croissant. Cocteau went ahead and designed his own and had Cartier make it up. The hilt was in the form of a playful Cocteauian profile and poet's lyre, with a symbolic theater curtain draped around the handle. On the lyre is an impressive emerald contributed by his friend Coco Chanel, the designer.

For some zealous new members, the épée's symbolism goes beyond esthetics and their personal history to encompass what they see as the Academy's role in the fight for French. "I will only draw it to defend our language," said one, "the French language, attacked mercilessly by ignorance and barbarism."

French will likely survive, though it may change somewhat faster than the Academy would like. The Academy, too, will probably continue to insure a subtle continuity as virtually the only French institution to survive the monarchy, the revolution, the empire, humiliating military defeats and five constitutions. Its resilience stems from its symbolic, indefinable nature. As poet Paul Valéry summed up the Academy, "We are what we believe we are, and what others believe we are, and neither we nor anyone else can say exactly what it is." In other words, if it didn't exist, the French would have to invent it.

Great race to enter the Academy was spoofed in this 1840 etching. Among those around Victor Hugo, as the legendary "Pope of Literature," are poet Alfred de Vigny (far left), Honoré de Balzac (under crown), Alexandre Dumas (holding dagger, in pointy slippers).

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Book reviews

Travelers of a Hundred Ages
Donald Keene
Holt, $35

When I was in Japan last year, I flipped on my host's television set and there was Donald Keene taking part in a discussion of a contemporary Japanese novelist. Innocent of the language, I had no idea of what was being said, but familiar with the body language of academic seminars, I could see that the American scholar and translator, who divides his time between New York and Tokyo, was quite at home in the Japanese literary-academic world. Keene's ease in that context helps explain why *Travelers of a Hundred Ages* is both a fascinating book and an odd one to offer to American audiences.

It is a collection of brief descriptions of Japanese diaries written for the newspaper *Asahi Shimbun*. The essays are introductions to the works, but given the original audience, they presume a familiarity with Japanese history that casual American readers will not have. Aware of the problem, Keene has added some explanations and provided a glossary, but a biographical list and a chronology would be useful. Despite the difficulties inevitable in such a collection, the book becomes absorbing because the material is intrinsically interesting and the diarists remarkably individual for writers in a genre that seems to invite conventional responses.

The works under discussion here range from the ninth-century *Record of a Pilgrimage to China in Search of the Buddhist Law*, written in classical Chinese, to Kawaji Toshiakira's account of his meetings with the Russians in Nagasaki and Shimoda when Japan was

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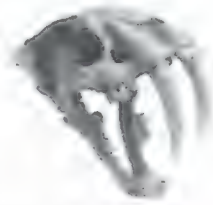

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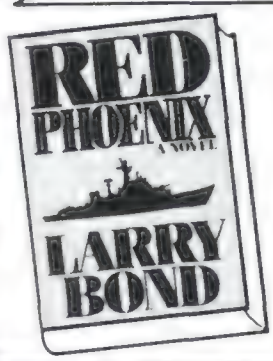

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reluctantly opening to the West in the mid-19th century. It was not until toward the end of this period that Takizawa Bakin kept the "first truly modern diaries": "We learn not only his life within his family, his work as a writer, and his daily round of activities but (indirectly, at least) his feelings about contemporary society."

Most diaries from the earlier centuries were more like memoirs or travel books written after the fact, polished works that were short on chronology, long on literary effects. They were punctuated with *waka*, the classic verse form that was a mark of cultural elegance whether the diarist was a court lady, a government official, a Buddhist priest or a professional poet. Writers occasionally protested, as Lady Daibu did in her 12th-century *Poetic Memoirs*, that "I intend these memoirs for my eyes alone," but none of them was written in code, as were the diaries of Samuel Pepys and William Byrd. Keene assumes that Lady Daibu "hoped, at least unconsciously, that someone else would read about her experiences." But then, Pepys, who left his diary with the rest of his library to Magdalene College, Cambridge, may have expected that someone eventually would decipher it.

The diaries of the court ladies of the Heian period (A.D. 794-1185) are often highly introspective and sometimes obsessive in their self-pity. Even Keene, who tends to warm to any evidence of a strong personality, gets impatient with the unnamed author of the tenth-century *Gossamer Years*, who so laments that she is not sufficiently loved by her husband that she comes to enjoy her suffering more than his presence: "I was absorbed in my own grief and paid no attention to him." And the octogenarian who wrote the 11th-century *Collection of the Mother of Jōjin, the Ajari* to punish her son, "an eminent ecclesiastic who was then over sixty years old," for going "to China in search of Buddhist learning." As Keene presents them, they sound as stagily angst-ridden as Hamm in Samuel Beckett's *Endgame*, who intones, "Can there be misery—loftier than mine?" Lady Daibu, who had greater cause of grief in the death of her lover, is at once more sensible and sympathetic: "I was not the only one to have endured such a short-lived and heartbreaking love affair . . . but at the time I felt that my experience was utterly without parallel."

As one reads these essays, one gets the sense of travelers hurrying head-down from one poetically approved spot to another. In Sōgi's 15th-century *Journey to Shirakawa*, he dismissed one site with "Not being a 'famous place,' it did not attract me." Bashō, the diarist best known to Western readers, conscientiously stuck to a literary itinerary. If a site did not live up to its poetic source, he looked at the poem instead of the place and, in polishing his response, invented when he "found the facts insufficiently artistic." So, it is refreshing to find the unknown author of *Journey Along the Seacoast Road* saying as early as the 13th century, "Famous places are not necessarily enjoyable. Places one has often heard about do not necessarily appeal to the eye."

The habit of seeing only what one wanted to see was more than a way of looking at landscapes. Some of the travelers managed to ignore the wars that raged around them during the Middle

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Ages. Most never saw ordinary people, a class blindness so pervasive that it is surprising and touching to have Chōshōshi, the *waka*-writing warrior of the late 16th century, take shelter in a rude fisherman's hut and wonder, "If I had been born in that station of life, what would have become of me?"

The individual faces that can be seen in Keene's narrative, and the individual voices that can be heard in the translated fragments, make one want to turn to the diaries themselves. Many of them are available in English, but unfortunately still more have never been translated. While you wait, there are Keene's newspaper pieces, newly translated, available in this strange and strangely tantalizing book.

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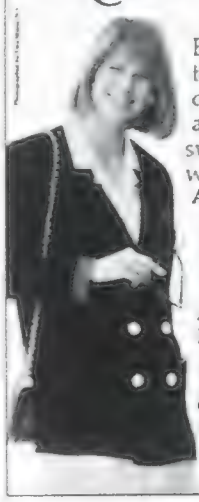

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nurses. . . ." She must describe the dancing classes and the balls, of course, the silk and velvet dresses.

And then, after her readers were thoroughly seduced by that world, she would reveal to them the reality of her marriage to the cold and cruel Duke of Marlborough, a marriage engineered by her mother, a marriage that transported Consuelo to yet another opulent setting—the duke's Blenheim Palace, grandest among the grand English houses—but one that afforded her no happiness.

Auchincloss' advice to Consuelo Vanderbilt reflects his own way of understanding America's Gilded Age. He is the Prendergast of historians, the Childe Hassam of biographers, creating in deft, swift strokes the shimmering surfaces of the Vanderbilt era, at the same time urging us to consider the reality of lives as they were lived and felt.

Auchincloss has an eye for the telling detail—the lace trim on Margaret Vanderbilt's sweeping blue gown; the intelligent green eyes that made Gertrude Whitney attractive, if not conventionally beautiful; the marble stairway, lined with servants, at Cornelius Vanderbilt's Newport villa, the Breakers; the grille gates of Cornelius' Fifth Avenue mansion. Like John Singer Sargent, the consummate portrait painter of the Vanderbilt era, Auchincloss shows men and women who were well groomed, well mannered and well situated, but not necessarily kind, not necessarily happy and not necessarily good.

At the turn of the century, the Vanderbilts were the new rich, reluctantly accepted by Old New York society, but nevertheless easily buying their way into elite circles. They were not exceptional people, as Auchincloss portrays them. Now and then a son or daughter would demonstrate an unusual sensitivity—Gertrude Whitney, for example, defied convention by pursuing a career as a sculptor—but the Vanderbilts were not known for their culture or taste. "Art," they believed, "was something one's decorator bought abroad."

The Vanderbilt clan become, in Auchincloss' skilled and attentive rendering, the prototypes of people we read about in novels by Edith Wharton and Henry James. In *The House of Mirth*, Wharton gives us characters modeled on such women as "Alice, Mrs. Vanderbilt," the title she gave Cornelius Vanderbilt's pompous widow. In James' *Portrait of a Lady*, we meet Gilbert Osmond, a collector as cold-eyed and coldhearted as Consuelo's duke. These are characters whose inner satisfaction rises or falls with the acquisition of yet another Louis XV table.

The Gilded Age has had no lack of chroniclers, but Auchincloss brings to his study a rare intimacy and a generous sympathy. He has, after all, sat with the aging Consuelo Vanderbilt and listened as she recalled youthful occasions she shared with her cousin Gertrude Whitney. "Gertrude and I were *heiresses*," Consuelo told him. "There seemed never to have been a time when this was not made entirely clear." Auchincloss' wife and his publisher are descendants of the dour Commodore Vanderbilt. Auchincloss is not a tourist in this world. But he is, for his readers, a witty, erudite and charming tour guide.

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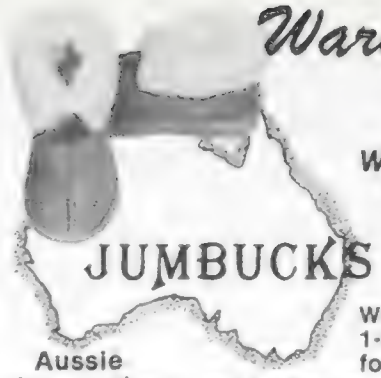

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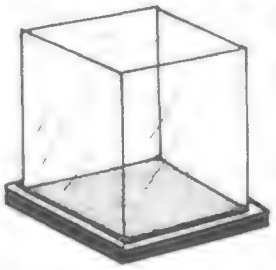

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Additional reading

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Badgers (p. 108)

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Smithsonian highlights

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The Castle has reopened with a new Smithsonian Information Center and Associates' Lounge. Hours are 9 A.M.-5:30 P.M. daily. The Freer Gallery of Art is closed until 1992.

Musical Weekend

Highlights of the 18th Smithsonian Musical Weekend, April 20-22, will include the Smithsonian Chamber Orchestra performing Beethoven and Haydn symphonies; dinner in the Castle; tea and music at the Australian Embassy; a performance on the Erard piano newly acquired from Balmoral Castle, and a champagne breakfast in the Bird House of the National Zoo. To obtain additional information, write: Musical Weekend, Box 11271, Washington, D.C. 20008.

Special January exhibits and events

National Museum of American History
Shawls in America (through October 1990) Stylish wraps from the Museum's Division of Textiles. See *Highlights continued*, page 170.
Greek Revival (January 17-March 31) Photographs documenting the history

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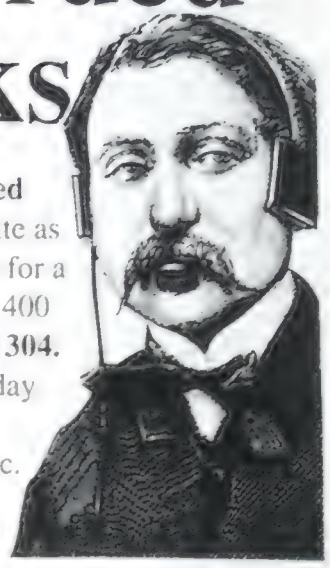

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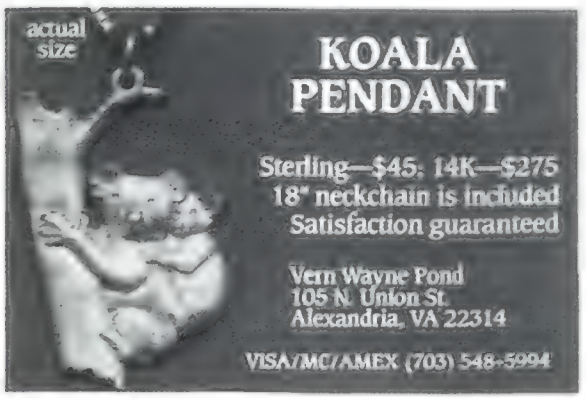

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Men and Women: A History of Costume, Gender and Power (through December 1990) An examination of culturally determined standards of appearance and behavior.

Anacostia Museum

The Real McCoy: African-American Invention and Innovation, 1619-1930 (through May) An overview of outstanding black inventors and anonymous innovators who made important contributions to American technology.

National Museum of Natural History

Nomads: Masters of the Eurasian Steppe (through February 18) Landmark exhibition featuring more than 1,000 nomadic artifacts from the major Soviet Union museums.

The First Egyptians (through April 1) The first major show to explore the world of predynastic Egypt, with more than 130 artifacts.

Portraits of the Giant Saturniid Moths (January 15-June 1) Works of John Cody

National Museum of African Art

Icons: Ideals and Power in the Art of Africa (through September 3) A survey of African art, focusing on recurrent themes.

Royal Benin Art Creations from court artisans, 15th through 19th centuries.

Renwick Gallery

Masterworks of Louis Comfort Tiffany (through March 4) Sixty-two objects, including leaded-glass windows, ceramics, bronzes and paintings.

International Gallery, S. Dillon Ripley Center

Caribbean Festival Arts (through February 15) Costumes, music, videotapes, photographs evoke the sights and sounds of the Caribbean street festival.

National Museum of American Art

Treasures of American Folk Art from the Abby Aldrich Rockefeller Folk Art Center (through February 19) Paintings to pottery and quilts, from the extensive collection.

The Patricia and Phillip Frost Collection: American Abstraction 1930-1945 (through February 11) Seventy-five

works by members of the pioneering American Abstract Artists group.

Arthur M. Sackler Gallery
India Along the Ganges: Photographs by Raghubir Singh (through April 15) Fifty dye-transfer prints by the acclaimed photographer.
The Noble Path: Buddhist Art of South Asia and Tibet (through March 31) More than 100 objects reflecting the changing imagery of Buddhism.

National Portrait Gallery
Portraits of the Law (through January 15) Images of distinguished judges, scholars and courtroom lawyers.
To Color America: Portraits by Winold Reiss (through April 1) The German-born modernist's 1920s and '30s depictions of American minorities.

Hirshhorn Museum & Sculpture Garden
DIRECTIONS: Susan Solano (through February 11) Works by the Barcelona sculptor.
Matt Mullican: WORKS (through March 11) A rug by the New York-based artist.

National Air and Space Museum
Commuting in the Modern Manner: The Grumman Goose Amphibian (runs indefinitely) A look back at the 1930s "limousine of the air."
The Aviation Careers of Igor Sikorsky (runs indefinitely) An overview of the aviation pioneer's achievements.
Carrier War in the Pacific (permanent) Six major battles through models, maps, photographs, films.
Beyond the Limits: Flight Enters the Computer Age A major new gallery explores the computer revolution in aerospace.

Cooper-Hewitt Museum (New York)
E. McKnight Kauffer: Graphic Art and Theater Design (through April 1) Retrospective look at the graphic designer's varied and productive career.
The Intimate World of Alexander Calder (through March 11) More than 300 whimsical works, from toys to caricatures.

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Smithsonian World: The television series opens its fifth season with "Zoo," featuring National Zoo Director Michael Robinson. January 24; check local PBS listings for times.

Resident Associate Program

To become a Resident Associate, or for fee and ticket information, call 357-3030.

The Tempting of America: An evening with the Hon. Robert H. Bork (January 24; 6 P.M.) The jurist on his new book.

The Practice of Law in the Nation's Capital: A Behind-the-Scenes View (six Tuesday sessions, January 30-March 6; 8-9:30 P.M.) Distinguished attorneys from Lloyd Cutler to Ralph Nader.

Smithsonian Institution Traveling Exhibition Service

SITES organizes and circulates exhibitions to cities throughout the United States and abroad. To sponsor a show in your community, write SITES, Smithsonian, Washington, D.C. 20560. Here are some January exhibits:

Concord, New Hampshire (through January 28) *Sea Stars*, St. Paul's School.

Hot Springs, Arkansas (through January 28) *Vietnam Veterans Memorial: A National Experience*, Garland County Library.

Indianapolis, Indiana (through January 28) *Tropical Rainforests: A Disappearing Treasure*, Indiana State Museum.

Madison, Wisconsin (through January 21) *Badges of Pride: Symbols and Images of American Labor*, State Historical Museum.

Seminars
(continued from page 91)

20th-Century Furniture *April 30-May 4* Washington, D.C. Join historians and furniture makers on visits to working studios and private collections.

The New Astronomies *May 13-18 or May 20-25* Arizona. Study with astronomers at the Smithsonian's Whipple Observatory.

French Impressionism *May 18-20* Washington, D.C. See special exhibitions at the National Gallery of Art.

Florence *May 26-June 10* Classes and excursions based in a villa-hotel.

Research Expeditions

Contribute your time, talent and financial resources to Smithsonian research. Work with curators at the Smithsonian or at field sites around the country and the world.

Cancún, Mexico *February 16-26 or February 27-March 9* Study birdlife and vegetation.

Washington, D.C. *March 4-16 or July 22-August 4* Archive historic aviation documents at the Air and Space Museum.

Costa Rica *March 31-April 12 or April 14-26* Monitor Arenal Volcano's eruptions and study local vegetation.

Washington, D.C. *May 23-June 6* Photodocument Memorial Day activities.

Washington, D.C. *June 6-16* Prepare anthropology collections of animal bones for transfer to a new facility.

Washington, D.C. *June 25-July 8* Photograph the Festival of American Folklife.

Montserrat *July 1-14, 15-28 or July 29-August 11* Excavate slave quarters and a cemetery at a Caribbean sugar plantation.

Cody, Wyoming *July 15-28* Collect plant fossils near Yellowstone.

Cheyenne, Wyoming *July 18-30* Document the annual Frontier Days rodeo.

New York City *August 8-18 or 20-30* Reconstruct pottery from the Caribbean.

For seminar brochures, call (202) 357-4700; for expeditions, call (202) 287-3210. Or, write to the address on page 91.

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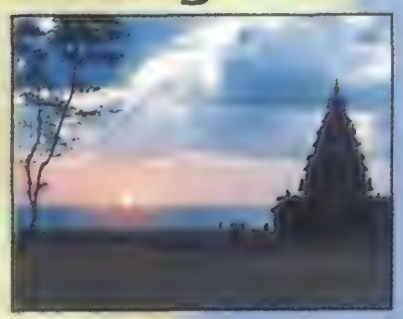

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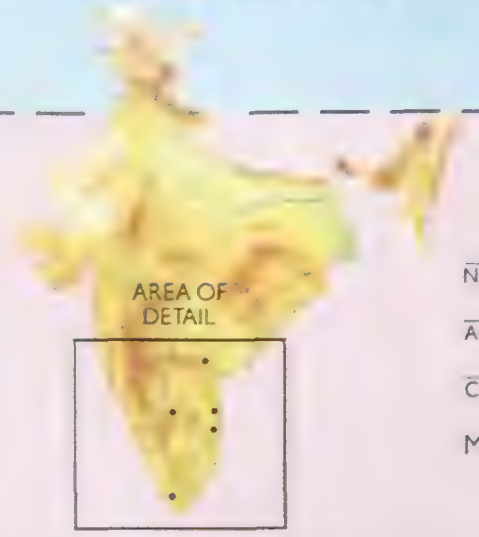

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Shawls for every season

It was the kind of serendipitous find that makes a curator's day. Rummaging around in an Exton, Pennsylvania, antique shop, Rita Adrosko discovered an unexpected treasure. Tucked away amid the furniture and china and flatware was the simple, arresting portrait of a lady (right). The 19th-century belle, a finely worked shawl wrapped round her shoulders, held a particular kind of enchantment for Adrosko.

As curator for the Museum of American History's Textiles Division, Adrosko was preparing an exhibit that would showcase 19th-century shawls—the brilliantly patterned wraps prized throughout the period. That winsome portrait is now among the centerpieces of NMAH's "Shawls in America," an absorbing look at one of America's most popular fashions—and the women who wore them.

Adrosko scoured sources as various as diaries, pattern books, fashion plates and ladies' magazines to document the provenance of shawls and their depiction in the popular culture. In contemporary prints and paintings, women ice skate and stroll and gather at prayer meetings—wrapped in the ubiquitous, sought-after shawl.

The shawl originated in India and the Far East as a traditional shoulder wrap. By the late 1700s, distinctively patterned shawls from Kashmir appeared in Europe as luxury garments for women. The high-priced, twill-tapestry Indian wraps soon gave way to European-loomed imitations, produced in centers from Paris to Edinburgh and Vienna.

The style spread throughout Europe and America, and remained a special fashion signature until the 1870s. Visitors to the show will also find a 13-foot-high Jacquard loom, the punch-card weaving machine that made large-scale production of shawls possible.

The exhibition continues through October 1990.

Kathleen M. Burke

Identities of both sitter and artist, from 19th century, are lost to history.

Scottish "Four Seasons Shawl," c. 1850, presents one square for each season.

Small wool-and-silk scarf, mid-19th-century, was likely woven in Scotland.

This British-made shawl of wool, silk and cotton is an elegant, reversible wrap.

Hand-brocaded wool shawl was woven, probably in Scotland, around 1810.

Distinctive bands at border embellish silk shawl, British, from early 1800s.

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"You'll see despair turn to hope, and you'll feel the personal reward of knowing what your love and support can do.

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By Chalmers M. Roberts

To celebrate or not— when *is the question*

At the end of my freshman year in college some old fellows turned up on campus for their 30th reunion. The oldsters had graduated in 1900 and were known as "oughty-oughts." Somehow, as the year 2000 comes closer, I have begun to wonder what the Class of 2000 will call itself. Certainly not "oughty-oughty-oughts." More likely, if today's jargon lingers, "2Ks."

Of course the substantial question is when to celebrate the dawn of the new century. Everybody knows the 21st century begins just after midnight of December 31, 2000. But everybody knows, at least judging by what happened last time, that celebrations will begin a year earlier, at midnight on December 31, 1999.

Besides precision, a host of problems hang on the nation's, indeed the world's, decision. For instance, when will "20th Century Fox" on the silver screen become "21st Century Fox"?

You might ask why anyone is bothering about such things with a decade still to go. In my case, since I was born in 1910, I figured I'd better get my word in edgewise lest I not still be using this typewriter (yes, an old Royal standard) when the crucial date(s) come round. So I began checking the record.

Historian Frederick Lewis Allen began his *The Big Change: America Transforms Itself 1900-1950* with this account: "On the morning of January 1, 1900, there was skating for New Yorkers in Van Cortlandt Park, and presently it began to snow. But the sharp cold had not chilled the enthusiasm of the crowds who, the night before, had assembled in Lower Broadway to celebrate either the beginning of the twentieth century or the beginning of the last year of the nineteenth: there was some disagreement as to the proper interpretation of the event, but none as to the size and liveliness of the gathering. . . ."

My favorite collection of historical minutiae, the six volumes of journalist Mark Sullivan's *Our Times*, starts with the "Turn of the Century," and I knew it would tell me when the century really turned last time. Sullivan, a rather sobersided writer and a member of Herbert Hoover's "medicine ball cabinet" (a truly dreary form of exercise), stated the facts: "Throughout 1899 there had been much discussion as to what day and year marked the close of the nineteenth century and the beginning of the twentieth. . . . Wherever men met they argued about it. Contentious persons wrote letters to the papers. Schoolchildren were set to figuring."

Sullivan credited Albert Shaw, editor of the *Review of Reviews*, with settling the question once and for all by stating that a "half-minute's clear thinking" would fix on December 31, 1900. After all, Shaw wrote, "none of the people who have proposed to allow ninety-nine years to go for a century would suppose that a $1,900 debt had been fully met by a tender of $1,899."

Yet Sullivan demurred. He personally would go with 1900 for a reason "which is not a reason at all, and not within the world of reason but within the world of imagination. January 1, 1900, appeals to the human imagination, seems to the eye, and sounds to the ear, more like the beginning of a century than does January 1, 1901." Sullivan had to concede that this meant his history of the first quarter of the 20th century thus would contain 26 years, as indeed it eventually did. From there he turned to the more important: the women's "shirtwaist vogue of 1900" and food prices quoted that year in the Omaha *World-Herald*: "sugar, 4c. lb.; eggs, 14c. a dozen."

Indeed, if you want to know what America was like at the turn of the century (pick either date), try Ralph K. Andrist's *American Century.* Andrist notes: "The arrival of the year 1900 brought an outpouring of editorials, sermons, and solemn punditry about the achievements of the past century and the challenge of the one ahead." Doubtless, past is prologue.

The *Washington Post* on December 19, 1899, loftily declared that the new century would begin January 1, 1901. When that date arrived, the paper ventured to editorialize: "We enter upon a new century equipped with every wonderful device of science and of art. But our primeval appetites and passions are untouched. The tailor, the shoemaker, and the haberdasher have disguised us outwardly until we seem to be Christians and philanthropists. But the pirate, the savage, and the tyrant still survive. Who shall dare to prophesy for the coming years?" I wonder if *Post* editors can top that thought this time round, be it 2000 or 2001.

The *New York Times* cleverly managed to have it both ways. It started the 20th century at midnight, December 31, 1900, but reviewed the 19th a year earlier, on December 31, 1899. Two days later the rival *New York Tribune* editorialized: "No new century began yesterday. Avoid all delusions on that head. But those who had to date anything found that there was a queer sensation in writing '1900,' and they felt that something momentous had happened to the calendar."

My point is simply that mathematics can't beat a sense of fate, as witness the millenarians who predicted the end of the world as we knew it near the year 1000 and will no doubt do so again as December 31, 1999, and January 1, 2000, inexorably approach. Meanwhile our hearts tell us that as soon as we hit that Big Two—2000—a humongous turn will have been made, and then and there we are into the new century. To see it I'll happily give up hoping to make the correct date. I'll be in my 90th year anyway.

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